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SHANGHAI, PEKING, TOKYO AND MANILA

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VOL. XIX SHANGHAI, DECEMBER, 1923 No. 12

Dollar Diplomacy in China

Who Will Profit by Intervention?

IT seems incredible that there are Americans so indifferent to the consequences of intervention in the affairs of this country that they are willing to be guided by publicity-seeking leaders into urging their government to take a step that would invite not only the permanent hostility of the Chinese people but turn all other Asiatics against them. The situation over which our government is asked to take control is without precedent. The Chinese seem to prefer the present chaos and disorder to any measure of foreign control. They would never consent to it and would unite to oppose it when they would unite for no other purpose. Their passive resistance would make it impossible of success ; their universal remedy of a boycott would immediately be brought into play against any nation or nations responsible for such interference with their affairs. Intervention on any scale to produce an improvement would involve a large organization. If such intervention was the result of international action would Americans have a position of leadership or even a permanent participation? Would Americans be content with less than equality with other nations in fact and in appearance in positions of control ? Where would the American government find competent and experienced persons with that profound knowledge of China as would enable it to maintain a leadership or even a secondary place in the shaping and execution of policies ?

If international intervention is undertaken, the Japanese would expect a prominent part and would be entitled to it. Their part would be efficiently taken, but the more prominent they become, the more obstructive would be the Chinese, the more abusive and suspicious their allies. This applies with equal force to Americans or British. Would the British be conceded the leadership in such intervention. Would they take the leadership in the sense that carries with it the main risk of a Chinese boycott? Their leadership would have certain advantages. There are, perhaps, more British subjects in the Orient available and fitted for such duties. If they should be put in charge, representing all the powers, the job would be well done, but Americans would suffer in pride, prestige and pocket. The British would take all the commercial advantages connected with such leadership—it would be all they could hope to get out of it. In any event, whether Japan or Great Britain takes the lead, Americans are likely to suffer commercially if they or their government participate in any plan to govern China in whole or in part against the Chinese will, particularly any international plan. If they should be foolish enough to listen to the call of the go-it-alone jingoes, every other foreign interest would combine to defeat them.

If the powers agree upon an administrative organization to carry out the grand undertaking, just what should they attempt to do ? Reform China's administration in all branches, in spots, or along one particular line? Should they just confine themselves to controlling her fiscal affairs and take over the levy and collection of all her revenues, reduce expenses to income and doing all that goes with it, or, simply try to keep order in China, awaiting—what ? Should the powers finance the huge deficit between present revenue and present current administrative and other expenses ? Should they take their own armies into China ? If so, under one command ? How many armed men would be required to control the situation, preserve law and order and insure the proper collection and remission of taxes to the central authorities ? Who will pay for this great army ; the foreign nations already bowed down under a load of past war debts, or will the enormous costs be added to China's present obligations ? Or, shall the representatives of the powers sit still, look wise and endeavor to enforce their plans without adequate backing at hand under their own command ?

Should the powers set about the disbandment of China's large armies ? Shall their arms be taken from them ? Is the vast organization needed for the commissary features of this job appreciated ? Of course, the arms can be left in the possession of the Chinese while the foreigners are trying to govern China ? The Chinese are most pacific and would not use them. Should any responsibility be assumed for the immediate future of the million or more disbanded soldiers? Shall they be sent to their homes, with money for travel and temporary living—say a matter of twenty dollars apiece—or more than thirty million dollars ? Should labor be provided for them or other means of support to prevent inevitable banditry on a greater scale than before as a means of sheer existence ? Is the extent of the lack of demand for labor realized ? Not counting the men under arms there are always millions of half-starved, idle men.

There are, perhaps, some super-Americans who can surmount these difficulties and direct a go-it-alone intervention from their swivel chairs in the Robert Dollar building at Shanghai, but they would be the only political geniuses and military leaders with the exact knowledge of China that our country could rely on to carry through to success such a stupendous undertaking. The secretary of state would be relieved of much anxiety and responsibility by the inner council which formulates national policies in Shanghai while the army and navy would be provided with a ready-made staff of trained tacticians who dashed across the Pacific at the first call to arms in 1917 and defied the enemy from the most advanced and exposed trenches on the Far Eastern front at Shanghai. The greatest American tactician had his headquarters in Shanghai at the outset of the great war and skilfully directed the German march on Paris from this dangerous position, until, wounded in self-esteem was forced to evacuate by the tremendous pressure of allied public opinion. As soon, however, as America entered the war, the little Napolean hastened back on the first steamer with a new chief-of-staff, assumed command of Far Eastern operations and drew up complete plans for the next war between his own country and Japan. The generalisimo has since retired. His most capable chief-of-staff who stood bravely at his side during the heaviest bayonet charges on the Shanghai trenches, is now in command directing preparations for the next great forward move. Since the plans for the Japanese campaign and Chinese alliance were pigeon-holed by the war college the dashing young general has been engaged in drawing up plans for an American invasion of China. Everything has been carefully thought out in advance, and when the commanders-in-chief of the American army and navy arrive in the Whangpoo they have only to report themselves to G. H. Q. on the Yang-king-pang, and receive instructions. Their work is cut out for them in advance. By that time the state department will

have practically ceased to operate in China and all official contact with the government at Washington will be carried on by a confidential staff officer appointed by G. H. Q. in Shanghai. This is by no means an exaggeration. It is simply the logical sequence to activities, intrigues and politics indulged by a group who rush in where angels fear to tread.

On the other hand, there are a few Americans at home and in China who have not yet attempted to ram their opinion down the throat of the government. These men, however, are very, very meek. They have to be, as they have learned to their cost that it is most disagreeable and unprofitable to oppose the erstwhile feldmarshal and the group who support him in penalizing all who hold opinions not in accord with their expert views. Now, we unfortunately belong to this penalized and " un-American " minority who entertain other ideas as to how American interests can be best advanced in this country. We are so hopelessly opposed to the plans of the militant oligarchy that we even believe that China should be left to work out its own salvation, no matter how long she takes, or how much injury is inflicted on American trade while she is doing it. China will probably continue for a long time to make an awful mess of things, but bad as this mess will be, no other country can do better. An end must come all things and there is still hope that the merchant and educated classes will bestir themselves to save their country from utter ruin. Intervention in China at this time will fail after precipitating a period of greater confusion and turmoil.

The craze for intervention which followed the Lincheng outrage has worn itself out. The Japanese have come to the very sensible solution that China is entitled to work out her own destiny in her own way and are determined to stand by her while doing it. British opinion at home has also awakened to the danger to their trade and prestige involved in the continuous demand for intervention, and at least two prominent newspapers have registered disapproval of the attitude assumed by the *Times* and *Reuter's* correspondents at Peking. American intervention would prove very profitable to trans-Pacific shipping lines by creating great activity in military, commissary and quarter-master shipments. It might also temporarily increase the circulation amongst the soldiers and sailors of some flag-waving jingo sheet but with a boycott on American goods as the result of such intervention, it is difficult to see where or how any other interests would profit.

There are many inarticulate Americans amongst those whose trade would suffer, who hold to the view that it would be better to confine American efforts to an American plan administered by Americans and concentrate on some particular object that will preserve our standing with the Chinese rather than create the opportunity for any favored group to profit at the expense of other national interests. This feeling is daily becoming stronger as the truth is being forced home that the misdirected activities of the militant minority are already undermining the feeling of confidence reposed by the Chinese in American disinterestedness, and unless these activities are repudiated, the ultimate effect will be a complete loss of American prestige in this country.

There is only one safe way in which the American government can render effective aid to China while she is passing through her transition period. There are high class, dependable and competent American engineers in China : one such American concern has recently finished a great engineering task in Shantung under a contract with the provincial government for the redemption of a large area flooded through a break in the Yellow River dyke. There are other important jobs of a similar nature. There is, for instance, the straightening of the Yellow River through the province of Honan. This river has killed more people than any other river in the world. The flood of 1887, when more than a million lives were lost, was a far greater disaster than the recent earthquake in Japan.

There is also the improvement of the Grand Canal that will restore this ancient artery of commerce and reclaim vast areas for cultivation, furnishing labor for several years to many thousands of suffering Chinese. The contract for its improvement was let by the Chinese authorities in 1916 to an American company, but as yet nothing has been done. Complete surveys and plans have been made, work could be started within two months notice and employment provided for least 15,000 men. Here is a real task, which, when completed, will permit boats of three to five hundred tons to pass through the locks where now only twenty-ton vessels can navigate the rapidly silting and narrow channel. Freight rates would be cut in half and the reclaimed areas provide sites for thousands of new farms and town lots whose sale would more than pay for the cost of the work.

Then there is the Hwai River improvement scheme, dovetailing into that of the Grand Canal, a stupendous undertaking that will eliminate floods and famine and bring contentment and prosperity to many millions of poor people who yearly face the destruction of their crops and homes. The Yellow River, the Grand Canal and Hwai River schemes are all more or less related, part of one huge problem that should appeal to the humanitarian side of all Americans. Then there is the construction of great trunk highways, opening up territories where the railway cannot hope to enter for another generation, creating immediate markets for American motor vehicles and bringing indirect benefits far exceeding the initial outlay. There is also the extension of common education in China, plans for libraries and other projects that will benefit the Chinese and bring cumulative returns to American trade.

Most of these schemes can be financed through the remainder of the Boxer indemnity. The funds that are now being expended to send students to American colleges might well be diverted for some years to these purely humanitarian development schemes. There seems to be little sense in continuing to turn out hundreds of college graduates each year, who, on their return to China, can find no employment outside of politics. The Boxer indemnity funds might be converted by special agreement to some scheme that will bring the greatest benefits at this time to the greatest number and not concentrated in defraying the expenses of youths whose families as a rule are fully capable of financing their superior education abroad. The claims of the great masses of China to a share in the benefits arising from the remission of this indemnity are far greater than the needs of a few hundred privileged students whose selection is now more a matter of politics than fitness.

The money need not be given to China unconditionally. By a carefully devised revolving fund plan with provision for repayments by the provinces or districts specially benefitted and by making use of the legitimate proceeds from the sale of the enormous reclaimed tracts, the fund might be the means of bettering conditions in China for the next fifty years. The plan is practical and feasible and will bring greater and more lasting benefits to the greatest number then the present system of flooding the country with returned students who cannot find employment.

Such a scheme is far better than intervention and will bring many indirect advantages to Americans and preserve the faith the Chinese have reposed in our good intentions towards their country. Such a scheme will promote American trade in every hamlet throughout the vast republic. Intervention without general Chinese consent would precipitate a boycott that would ruin every American trading interest in this country with the sole exception of the very limited few who would, profit enormously by this application of the new Shanghai conception of dollar diplomacy.

G. B. R.

Changing Friendships

ALL observers of conditions in China agree that the day of the anti-Japanese movement is over. Everywhere the people are more friendly to Japan and are in favor of a closer relationship between the two countries. The earthquake naturally has had something to do with this change in sentiment. The Chinese people are fundamentally decent and will not take advantage of an act of God. But the earthquake came much after the change set in. The change is the result rather of a more favorable policy in Japan toward China and a realization on the part of the Chinese people that disturbed conditions and economic chaos only result from boycotts and the confounding of international relations with domestic politics.

Most of the anti-Japanese tendencies in recent years were the direct result of internal politics. The "ins" always tried to be on friendly relations with Japan. The "outs" always attacked the "ins" as traitors. The most anti-Japanese group for some time has been the Chihli faction, but now that it is in power and has to do business on a basis of keeping itself in power, it has made its peace with Japan.

The point of the matter is that two nations as closely related to each other as China and Japan, cannot be in a healthy economic position as long as they keep quarrelling, particularly when there is nothing to quarrel about. And the Chinese is a sufficiently good business man to know that. He knows that he has lost more boycotting Japan and disturbing his own business conditions than the Japanese have lost, and he knows also that whereas the Japanese are organized for recoverry, he is not.

The textile industry of China proves the point. During 1919, 1920 and even as late as 1921, the Chinese cotton mills were the pride of all progressive persons in China. They wrote articles about the wonderful progress being made. Dinners were given; speeches were made; certain individuals gained an international reputation as the leaders of a great industry which eventually would put Manchester and Osaka to shame. What is the result to-day? The textile industry of China is in a condition of chaos and decay, appalling as it is discouraging to all the friends of China. Mills are closed or running half-heartedly. The industry has lost its force and it would be impossible to sell a cotton mill share on any market at a respectable figure. The industry has gone to pieces not because of bandits and soldiers, but because of too much politics, labor troubles, poor organization and confusion of ideas. It has gone to pot because it lacked recuperative strength to overcome the evil effect of chaotic condition engendered to some extent by the very men of the industry who to-day are seeking the friendship of Japan to pull them out of a hole of their own digging. Altogether unassisted by foreign capital and foreign management this industry will never recover and present indications are that the assistance will only come from Japan.

China has often changed her friendships. There was a time when Russia was the most hated of nations. America has suffered from these sudden veerings of affection. Regional friendships and changing friendships are always evident. For instance, when the Chihli party was opposing Japan because Chang Tso-lin was said to be favorably disposed toward Japan, all parties in Yunnan, Kweichow and Kwangsi were bitterly anti-French. And they still are. During the Washington conference, a returned student attached to the Chinese delegation attempted to stir up an anti-American sentiment because he personally disagreed with what was being done. That sort of thing is always happening, and it is always costly to China. China always pays the bill. And her misfortune is that the masses of the country, a healthy, sturdy, hard-working, friendly people know no way of resisting these forces of evil in land, these men who stir them to passionate loves and hatreds of friendly powers, who desire now only to see in China peace, order, good government and a prosperous people with money enough to buy goods.

Childish Perversions

POLITICIANS in China are utilizing the disturbed conditions of the country for the purpose of enriching themselves. The politician in China is a different breed from the militarist, who leads bandit and coolie armies to plunder. The politician is generally an educated man, perhaps even a returned student from some European or American university. He has not the excuse of the militarist that he is old-fashioned and without clear ideas of the proprieties of statecraft in a modern world. He knows. And when he plays China for a sucker and holds up foreign interests because he feels that the foreigners will not utilize strong-arm methods to protect their rights, he knows exactly what he is up to.

The worst offender in this direction is Chekiang province, the *tuchun* of which holds his office and exercises his influence largely because of foreign friendship and support. He used to be the defense commissioner in Shanghai and made a splendid record with the result that foreigners, regarding General Lu as enlightened, favored his promotion. His opponents have never been able to unseat him because the foreign city of Shanghai serves as a bulwark against attack. Yet this same General Lu, as *tupan* of Chekiang, has been devising every possible scheme for damaging foreign trade and commerce in his province.

Not only has he imposed illegal taxes, but he is now seizing houseboats belonging to foreign firms and it is even reported that he has taken possession of godowns, of one because the name of the foreign company was painted on the building; of another, because it was not. This same official imposes an illegal cigarette tax because he claims independence from Peking, its laws, mandates and treaty obligations; at the same time he refuses to respect foreign trade-marks because they have not been registered with a new trade-mark registration bureau, the *bonâ-fides* of which has not yet been recognized by the diplomatic corps in Peking. He utilizes his alleged independence to hurt foreign trade; he ceases to be independent when he can hurt foreign trade better by recognizing Peking. His political aim, of course, is to damage the position of the Peking government *vis-à-vis* the foreign powers. His actual achievement is to upset the economic conditions of his own and neighboring provinces and to damage the foreigner's business.

Lu Yung-hsiang is not alone in this nefarious business. He is perhaps little to blame, for he is one of those ignorant militarists who really know not what they do. To blame are the educated politicians who work out these schemes and who make fortunes out of them. Of all the money collected for the cigarette tax perhaps not more than 10 to 15 per cent. goes to the province. The remainder goes into the private pockets of the provincial assemblymen and the tax-farmers who devised the tax. In Kiangsu province, that is exactly what is happening to-day. The *tuchun* and civil governor are both opposed to the tax as illegal and the *tuchun* has made a public statement to that effect. But the provincial assemblymen want the tax and have put it through because of what they can get out of it. It is reported that the tax-farmers will be a group of provincial assemblymen and that the officials are rather fearful to interfere with what rapidly will become a vested interest.

In Anhui, Honan, Hupeh, and in many other provinces the politicians are doing everything possible to utilize the generous spirit of the foreign powers since the Washington conference to further their own ends. From Anhui reports come that the transit pass of the Chinese maritime customs, which is suppose to exempt goods from the *likin* tax, is refused recognition by *likin* collectors. One can go right through the country, up to the very gates of Peking, and perhaps beyond, to find well-planned attacks on the treaty rights of foreigners.

The solution of the problem, of course, is concerted action of the powers in making it clear to these young politicians that trickery never got anything for a nation, that sooner or later the powers grow weary of tricks and childish pranks and will set the house in order and spank the child. They have got to be shown that a treaty obligation will be enforced in China and that although it is admitted that some of China's treaties are unilateral in their benefits, China must place herself by her own means, in a position of ending an umbrageous position. Great Britain, the United States, Japan and other powers have not reached their present position through the charity and friendship of any other nations. The position will be the same with China. It is up to her to modernize herself and to become a decent citizen of the world if she wants to end the period of extraterritoriality and of limited autonomy. But she won't end them by trickery and deceit and indecent treatment. She won't end them by regarding treaties as scraps of paper. She won't end them by ignoring contractual relations. The conduct of her politicians to-day is only tightening the noose around China's throat at the one moment in her modern history when she had a chance to free herself by legitimate means of all unfavorable conditions.

A Study on the Fluctuation of Copper Currency

By Wu Yuan-hai

THE problem of copper currency is the most complicated in the study of the money system of China. It is by far harder a problem than silver currency, no matter from whichever standpoint we look at it—from the historical standpoint, or the political, or the economical, or the financial, or the social. But we must be aware of the fact that, it never really become a problem until the end of the late Manchu dynasty; and since the installation of the republican government, following after many other social, political and economical problems, it has begun to attract the attention of the public, and become more important since the year 1919. Up to the present, the problem is still unsolved, and most probably will become a national problem since, and will be seriously studied both by the practical and the theoretical.

Position of Copper in the History of Chinese Coinage

When we look into any authentic history of the Chinese nation, we will at once find out that, the history of the adoption of copper as a medium of exchange is as old as the history of the country itself. It is true that silver was also denominated in transactions at a later date, but it had never been put into the form of coins until the later part of the Manchu dynasty, when the eagle dollar was introduced into this country and found convenient, so similar form of silver coins were being minted. Although the term "tael" had been in usage much earlier, but it is an abstract measurement, and no such coin as representing a tael has ever been made. In reality, China has a copper period up to the second half of the last century, when foreigners came in and brought with them the silver currency.

The present is the period of transition from copper into silver. Both by virtue of the law for the national currency and the rising of the standard of living, silver has gradually gained its place as standard money in commercial centres and large cities. Whereas in the interior and in smaller cities copper still retains its old day prestige.

As a result, China at present is having a bimetallic system of money, with its peculiar characteristic of being composed of silver and copper instead of gold and silver. In fact, both copper and silver are given the full legal tender by the usage of society in spite of the law for the national currency. According to the currency law, copper coins, as subsidiary money, are legal tender only up to the value of one dollar in one transaction; while in practice conformity to this law is not at all taken into consideration. In such a state of monetary system, unless a fixed ratio of exchange between both metals are established and enforced by law, the monetary system itself will be deteriorated and hence occasion serious consequences, as in the case of China to-day, under unlimited coinage and legal tender, in unlimited amounts.

Now copper coins are by law subsidiary money, but in fact its coinage is unlimited and legal tender full. On the other hand, if we take it to be a standard money side by side with the silver dollar, we find that its intrinsic value is not up to the fixed ratio as it should be. At once the matter becomes the most serious at this time of the history of Chinese coinage.

Causes of the Depreciation of Copper Coins

(1) Overminting of New Copper Coins.—In fact it is unlimited minting. These new coins appeared first in the year 1919. According to the report of the Tramway Company in 1921, there were 27 new copper coins in every 1,000 coins the Company received in 1919; while at the end of 1920 the amount rose up to 84 per 1,000, and in January 1921 to 108 per 1,000. Take for instance the 10-cash copper coins, in 1915 there were about 22,000,000,000 pieces in circulation; and in the years 1919 and 1920 the amount of new coins increased made up a 12 per cent. of the total, i.e., 2,600,000,000. Another proof of the overminting of copper coins comes from the trade register of the customs house. The import of brass and copper has been increasing during the recent years. In 1913 the total value of copper and brass imported amounted to 7,372,000 H.K. taels. In 1914 the amount was slightly increased; while in 1915, 1916 and 1917, the amount had been considerably decreased. Suddenly in 1919 the amount rose up to the double of the amount of 1918 which was a little higher than that of the preceding year. In 1920 the amount was increased to as much as 12,935,489 H.K. taels. Now this confirms our first fact that in 1919 the overminting of new copper coins began to take effect. We also must bear in mind that very little of the imported brass and copper was put into industrial or art use, which again proves the fact that the greater portion of them was minted into copper coins. Such reckless minting is mainly due to powerlessness of the central government, and hence the practical independence of the warlords who have found the minting of copper coins a very good means to enlarge their private treasuries. Minting machineries are imported to this country every year, and when they cannot find time enough or facilities enough, they used to entrust the business of minting to a certain foreign country secretly.

(2) Debasement of the New Copper Coins.—At the first sight one can easily reveal the fact that new copper coins are thinner than the old ones, and hence lighter. Upon an analysis, we further find out that the copper content of the new copper coins is not up to the prescribed percentage by law for the national currency. At an experiment on 50 different kinds of copper coins, we find out that about one-third of the new coins are at an average not up to the lawful weight, and certainly more than half of them fail to have enough copper content. As to the old coins in these 50, all of them manage to pass the standardized weight and content. To state part of the law for national currency, every 2 cents copper piece should have a gross weight of 28 candareens, and a copper content of 95 per cent.; while every 1 cent copper piece, a gross weight of 18 candareens, and fineness same as 2 cents copper piece. As to the difference between the 1 cent and 2 cents new copper in respects of weight and fineness it naturally follows that in both respects the former is the more worthy.

(3) Unlimited Amount in Individual Transactions.—"The amount of copper pieces involved in one transaction shall not exceed $1.00":—this is the article in the law for the national currency in respect to the legal tender of copper coins. As copper coin is a subsidiary coin, so its legal tender must be restricted. But Chinese customs and usage do not conform to this restriction. As copper coins had for quite a long time been popularly used and socially recognized as the standard money of this country, so in this particular time of transition, unless the government is strong enough to enforce this restriction, such unlimited transactions will of course encourage and render the unlimited minting of debased copper possible. China should be considered to be a country in which such things as "System of Money" and "Standard Money" are merely terms in scraps of paper, and in fact no system of money or standard money has been in existence.

(4) Extravagant Issuance of Copper Notes.—Paper is surely much cheaper than copper. Then according to Gresham's law cheaper money will drive out dearer ones. However, in the case of copper coinage this law does not work to that extent as it should. Instead of being driven out by cheaper copper notes, copper coins have been affected by the notes and brought to the same exchange level with them. This result is just the opposite to the result of silver notes. We, of course, wish to know the reason why silver notes must either drive out silver bullion or silver coins or depreciate their own face value; whereas copper notes

do not drive out copper coins or depreciate by themself, but make the copjer coins to depreciate side by side with them. This is a matter of psychology. Generally speaking, people do not consider the value printed on the copper notes are large enough to necessitate a questioning into the credit of the parties who issue them. On the other hand, the minimum face value of any silver notes is one dollar, which is, of course, a considerable amount to the average Chinese citizen. Such would certainly causes copper currency cheaper in places where copper notes are issued, but the difference will never be very great until Gresham's law begins to take effect.

Cause of the Appreciation of Copper Coins (Especially in the Last Few Months)

It is a very abnormal happening to find that all the public had long been troubled by the depreciation of copper coins and just able to device some means to prevent its growth, now there suddenly arises the problem of the unprecedent appreciation of the same copper coins. We all just hope that the market value of copper coin will not depreciate any more, but suddenly we are afraid it might appreciate too high. This problem is new and has come to existence only for a few months, so it is still out of our power to ascertain what are the real causes of this appreciation. Yet we can get the general opinion of the public, which certainly will give us the explanation at least for the present.

Almost every reasonable person in Shanghai will tell you that the recent rising of the market value of copper coins is due to speculation. Some body or party is controlling the whole scene at the back of the curtain. We cannot say who are to call to account for this rising, but the ones who have the greater portion of copper coins in their hands are the ones mostly suspected. There are two reasons to believe in this explanation. Firstly, although new copper coins are prohibited to be shipped to Shanghai, but smuggling is still getting on pretty well off; and furthermore we certainly can assert that the coins that have already been put into the Shanghai market are still remaining in the same place, as generally their market price is cheaper in other seaports or interior cities. Secondly, the people and merchants of Shanghai have learned to speculate since the beginning of the great war (of course they also practised speculation in former days, but not so varied and unscrupulous), and after the bursting of the stock exchange bubble, they have found nothing to meddle with and just happened to find a victim in copper coin.

Effects of the Fluctuation

(1) Harm to The Money System.—Copper coin is a subsidiary money; and so beside the intrinsic value, the mint value, and the face value, it should not have any market value. As soon as it is given a market value it must either become a commodity or somehow or other considered to be one of the standard money also.

(2) Injury to the Small Shop-keepers.—Take the Tramway Company as an example to compare with. In the fifteen years between 1908 and 1921 the Company sustained a total loss of $4,102,933, ranging from $50,812 to $658,572 per year. Now the Tramway Company is a large company, so although the loss is great but the profit in business will compensate for it. It is really the small shop-keepers and the wage-earners who suffer the most and feel it the least. It is not uncommon to find that the small shop-keeper had to sell his goods at the old prices, while because of the exchange he buys at a higher cost. As to the wage-earners, inspite of the repeated demand made upon the employers for a raising of their wages, yet the rise in wages can never be proportionate to the rise in price of goods. At this point we might just as well point out that the recent prevalence in strike among the Chinese factories is none the less due to the depreciation of copper coins.

(3) Injury to the Average Citizen and Wage-Earner.—As a rule, whenever the exchange value of money in use is depreciated, there will follow a general rise in price. Copper is commonly used in retail transactions, so any changes in its exchange power will affect nothing of the wholesale prices of goods. Certainly the average citizen and the wage-earner are the ones to suffer. In recent years the wholesale prices of certain goods have a tendency to rise also: this is due to the fact that demand is greater than supply. But some goods, when their wholesale prices do not rise or even drop, and yet their prices rises in the market, which fact is certainly a result of the depreciation of copper coins. One most important fact to be borne in mind is that, prices of goods will never resume their old standard again, even though the price of copper coins may be dropped. The recent appreciation of copper coins affords a good proof: practically not one of the daily necessities or other sort of commodity has been lowered in price. Instead of what we expect, prices of goods shows sign of rising upon every fluctuation of copper coins. This is the only and the safest way of the small shop-keepers to prevent themselves from being involved. Consequently, the common people will suffer.

Remedial Measures

(1) Prohibit Influx of Copper Metal.—As we have seen in the preceding paragraph most of the brass and copper imported are but into coins, so the best way is to check their unlimited importation. Then the provincial mints will not find enough copper metal to mint coins to the fullest extent.

(2) Stop New Copper Coins being Shipped from One Locality to Another.—That is to say, every locality regulates its own need and lets just the right amount of copper coins to float in the market. Such measures have generally been adopted by commercial and political authorities.

(3) Establish a Law to Punish the One Who Speculates.—This is necessary. There is a law that prohibits using too much an amount in one transaction, so there are orders that stop over-shipping. But there is no law or order from any authorities that prohibits people hoarding up a large quantity of copper coins with the main purpose of creating a better market and hence reaping profits.

(4) Supervision of the Various Mints.—Minting of subsidiary coins will give some profit, and this is what most of the governments of the world take to be compensation for the loss in minting the standard coins. Certainly the minting of debased subsidiary coins will yield still greater profits. Thus supervision is needed with regard to the number, weight, and contents of the coins.

(5) Giving Every Description of Copper Coin a Market Value of Its Own According to What it Worths.—Not according to its face value, but according to its intrinsic and extrinsic characteristics, a copper coin is given its market value or price. There is a general tendency towards this respect, for instance, in the market we find the price of lighter coppers cheaper than that of the heavier ones, but, of course, the discrimination has never been made so accurate, and the assortment not so strict.

Radical Measure

Radically speaking, the fluctuation of copper currency is a natural outcome of the government's lack of ability to enforce the law for the national currency. A coin, no matter standard or subsidiary, has no price but has value. The standard coin is self-contained, so there is no question with regard to its having a price or market value as it is economically termed. But in the case of subsidiary coins, they have an intrinsic value, a mint value and a face value. It is not self-contained,—its face value is greater than both its mint value and its intrinsic value. So long as the government can limit the amount of them according to the need of the people, and restrict the amount in individual business transactions; as well as afford to receive or exchange them according to their full face value, there is no question about the depreciation of the subsidiary coins. The Chinese government cannot fulfil all the requirements, and thus copper coin, as a subsidiary money, will always acquire a market value (price) irrespective of its being new or old, relatively heavier or lighter.

THERE are thirty electric power companies in central Japan, practically all of which are hydro-electric developments. This section is also the scene of Japan's largest cities and industries, so that within a circle of 150 miles radius are located both the nation's principal users of electric power and her principal sources of supply.

So generous was nature in providing waterpower sites in Norway that to-day electricity, water-derived, is in very general use. With less than three million inhabitants, Norway stands second to America in the prevalence of electric cooking and heating. The consumer buys his electricity at so much per year instead of on a current consumption basis.

Japanese High Voltage Power Transmission Systems—II

By S. Q. Hayes, General Engineer, Westinghouse Electric and Manufacturing Co.

From "The Electric Journal"

Super-power **systems in the eastern part of the United States and in California have been thoroughly discussed in the American technical press within the last few years, but little has been published about smilar developments in other countries, so that Japan's progress in high-voltage power transmission should be of interest. In this article, it is the intention first to take up some of the more general features in connection with the larger power transmission systems and then to go into further details relative to certain interesting features of the generators, transformers, synchronous, condeners, switching equipment or other important devices.**

(*Continued from page 699*)

IN Osaka, the Daido Electric Power Co. may arrange to tie in their system with that of the Osaka Electric Co. and later may make connections with the Nippon and Ujigawa systems. Within the next ten years the combined output for these four systems, feeding into Osaka, will be about 1,000,000 k-v-a.

Osaka Electric Light Company

The main interconnections of the steam plants of the Osaka Electric Light Co. are shown in Fig. 10. At the Kasugade No. 1 station, there are three 12,500 kv-a turbogenerators supplying power in bulk to the West Ajikawa station. The Kasugade No. 2 station is provided with two 25,000 kv-a, 11,000 volt turbogenerators feeding through oil circuit breakers to a double set of bus-bars. These busses supply three groups of feeders, one for the local service, one connecting to Kasugade No. 1 and one connecting to East Ajikawa station.

In the West Ajikawa station, there are five 3,000 kv-a turbogenerators connecting to a sectionalized bus. Tie feeder connections are made to the East Ajikawa generating station.

In the East Ajikawa station, there are two 5,000 kv-a generators and one of 12,500 kv-a. The generators are connected either to groups of feeders or to a sectioned main bus. Fig. 10 does not show any of the tie connections to the Daido circuits but indicates 125,000 kv-a in steam turbogenerators on the system.

Nippon Power Company

In competition with the transmission system of the Daido Electric Power Co. and the distributing system of the Osaka Electric Light Co., the transmission system of the Nippon Power Co. and the generating and distributing system of the Ujigawa Electric Co., supply power to the Osaka district. For a number of years the Ujigawa Electric Company has been transmitting power at 55,000 volts, 60 cycles, about 21 miles to the Noe substation and an additional six miles to the Osaka substation.

The increasing demand for power in Osaka led to the development of hydro-electric installations at greater distances from Osaka and the Nippon Power Co. was incorporated for this purpose. The active work on the Nippon system at present covers the transformer station at Sasazu, a generating station at Seto, several switching stations, and the receiving station at Osaka. Probably the next installation will be a new steam station at Osaka.

The equipment at Sasazu is based on two incoming lines at 60,000 volts, with two 25,000 kv-a transformer banks stepping up from 60,000 volts delta to 154,000 volts star. A tie connection to the 154,000 volt Daido transmission system will be made later.

The Seto power plant, now being built, is to contain four 7,500 kv-a, three-phase, 11,000 volt, 400 r.p.m. waterwheel generators with direct-connected exciters and one motor-driven exciter. Connections are made with two 5,000 kv-a generators in the neighboring station of Maseyama. There will be two banks, each consisting of three 5,000 kv-a single-phase transformers, stepping up to 145,000 volts.

Not far from the Seto station is the Seki switching station where tie connections will be made to the systems of the Hakusan Water Power Co., and the Daido Electric Power Co. From the Seki switching station to the terminal station at Osaka is a distance of 132 miles. A number of switching stations will be used for sectionalizing the 154,000 volt transmission lines.

The main function of the Nippon Power Company is to furnish power to Osaka to supplement that supplied by the Ujigawa Electric Company. At the Osaka substation, now under construction, the switching equipment will control the following circuits :—

Two 100,000 kv-a, 140,000 volt three-phase 60 cycle incoming lines.
Two banks of 30,000 kv-a each, 140,000-50,000-11,000 volt step-down transformers.
Four 25,000 kv-a, three-phase, 50,000 volt, 60 cycle outgoing lines.
Two 25,000 kv-a, 11,000 volt *synchronous condensers.*
Four 5,000 kv-a, 11,000 volt, three-phase, 60 cycle outgoing feeders.
Two 140,000 volt busses with tie switch.
Two 50,000 volt busses with tie switch.
Two 110,000 volt busses with tie switch.
One grounded neutral circuit of transformers on the 140,000 volt line.

The oil circuit breakers will have rupturing capacities of 4,300 amperes for 154,000 volts, 8,000 amperes for 50,000 volts and 33,000 amperes for 11,000 volt circuits respectively. Provision will be made to supply

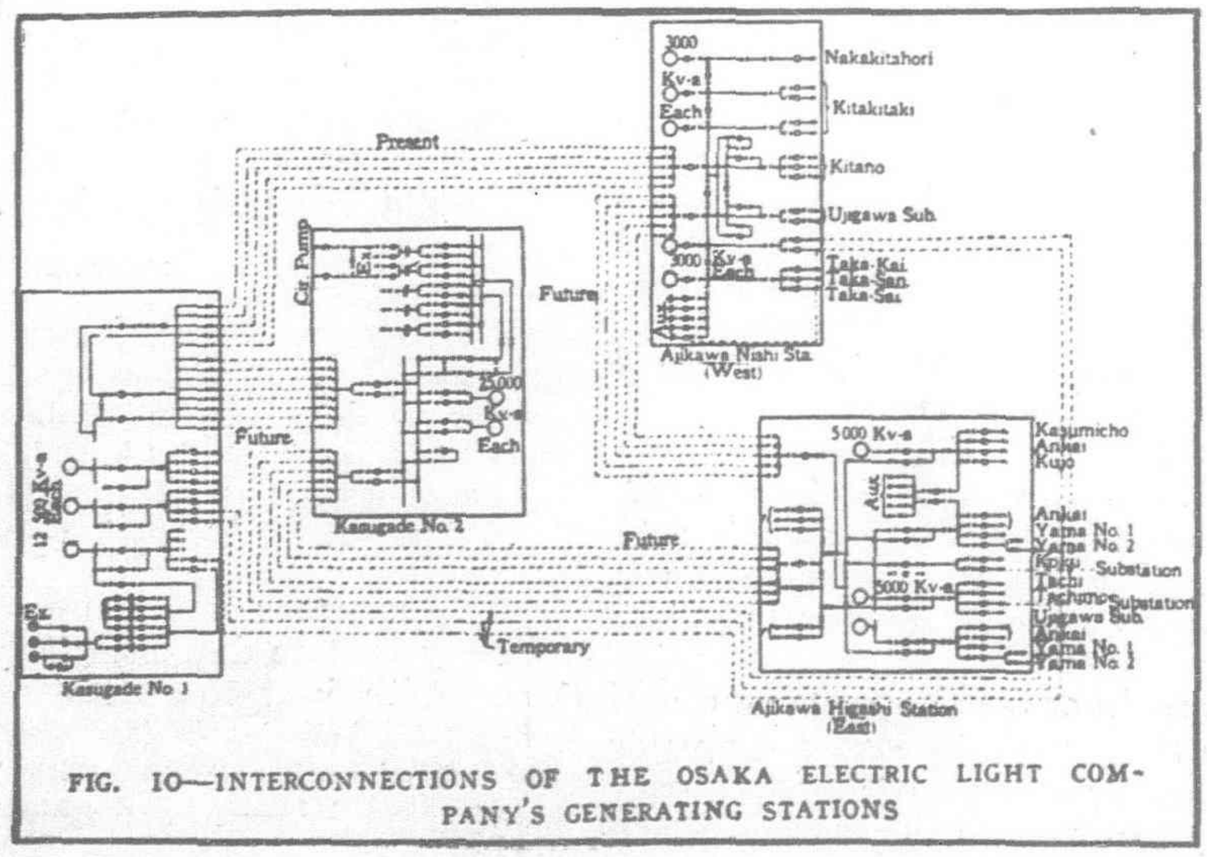


FIG. 10—INTERCONNECTIONS OF THE OSAKA ELECTRIC LIGHT COMPANY'S GENERATING STATIONS

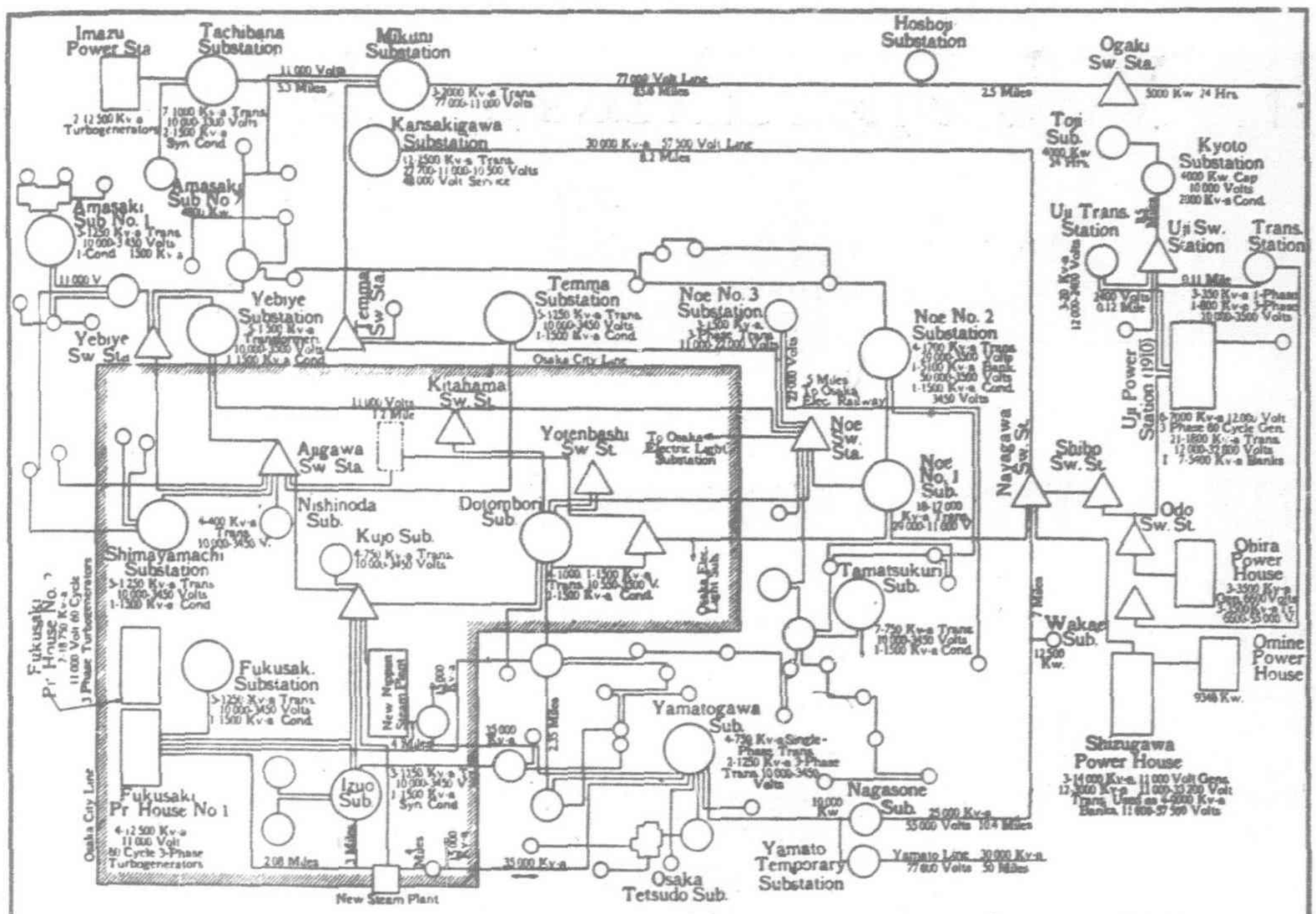


FIG. 11—GENERAL CONNECTIONS OF THE UJIGAWA ELECTRIC COMPANY'S POWER SYSTEM

oil for the outdoor circuit breakers, with a congealing point of—40 degrees C. to prevent it from freezing.

The transformers for the Osaka substation comprise seven single-phase units arranged in two banks of three each with one spare. The capacity of each bank is 30,000 kv-a at 140,000 volts, for the star connected primary, with two full capacity five per cent. taps and reduced capacity taps for 120,000 volt service. The capacity of the secondary winding is 37,500 kv-a at 50,000 volts star with seventy-five per cent. lagging power-factor, and the capacity of the tertiary winding is 25,000 kv-a at 11,000 volts delta. The 140,000 volt winding is connected to the incoming lines, the 50,000 volt winding is used for outgoing power and the 11,000 volt winding is for 25,000 kv-a synchronous phase modifiers and outgoing feeders.

The synchronous phase modifiers are three-phase, 60 cycle, units having a capacity of 25,000 kv-a at zero per cent. leading power-factor and 17,500 kv-a at zero per cent. lagging power-factor. Each unit is provided with a 250 volt, shunt-wound exciter and a wound secondary starting motor which is capable of starting the phase modifier and bringing it up to speed three times in succession with three minute intermissions, and is capable of driving it for a period of 30 minutes when charging the transmission line for synchronizing with other systems at Sasazu.

The 50,000 volt feeders from the Osaka substation will connect with the Noe substation and the new steam station of the Nippon Power Company and possibly form part of a 50,000 volt ring bus around Osaka. The 11,000 volt feeders probably connect to the Fukusaki steam generating station of the Ujigawa Electric Co. and supply power to several substations.

Ujigawa Electric Company

The general connections of the Ujigawa Electric Company are shown in Fig. 11, the connections to the Nippon system being made through the Noe substation and other points.

Lake Biwa, the largest lake in Japan, has for its outlet the Ujigawa (Uji River). A short distance from the lake there was installed, in 1909, the first hydro-electric station of the Ujigawa system. This plant, the Uji power station shown in Fig. 11, originally contained five 5,500 kv-a generators of German make which were not satisfactory and were replaced by 7,000 kv-a Japanese built generators, so that the station now contains six 7,000 kv-a generators, one being a spare, wound for 12,000 volts, and seven 5,400 kv-a transformer banks, one being a spare, which are connected delta low-tension and star high-tension for 55,000 volt service.

Two 55,000 volt outgoing feeders, from the Uji power station, pass through the Shibo and the Nayagawa switching stations to Noe. Lines are tapped into these 55,000 volt feeders, at the Odo switching station, from a second hydraulic station, the Ohira plant which contains three 3,500 kv-a generators and three 3,500 kv-a three-phase transformers. The Shizugawa station, now under construction, will contain three 14,000 kv-a, 11,000 volt generators, and will have a tie connection to the Omine station. The Shizugawa station will contain four 9,000 kv-a transformer banks and will have two outgoing 55,000 volt feeders tying in at the Nayagawa switching station.

To supplement the hydro-electric power, the Ujigawa Power Co. has the Fukusaki steam station in Osaka. One part of this station contains four 12,500 kv-a turbo-generators which supply power to fifteen 11,000 volt outgoing feeders; the newer part has two 18,750 kv-a turbo-generators.

In Osaka and vicinity, there are about twelve important substations, each having one or two synchronous phase modifiers of about 1,500 kv-a rating and a total installed transformer capacity of about 75,000 kv-a. Other stations without phase modifiers have a total capacity of about 25,000 kv-a so that there are roughly 100,000 kv-a available, at 3,500 volts, for the local distribution in addition to large amounts of power distributed at 11,000 volts.

The Ujigawa system is used primarily for power distribution and requires special permission to supply current for lighting purposes, as the Osaka Electric Light Co. takes care of the lighting requirements of Osaka and vicinity. Power is supplied at 11,000 volts by the Tamatsukuri substation to the Osaka Electric Railway at

(*Continued on page 760*)

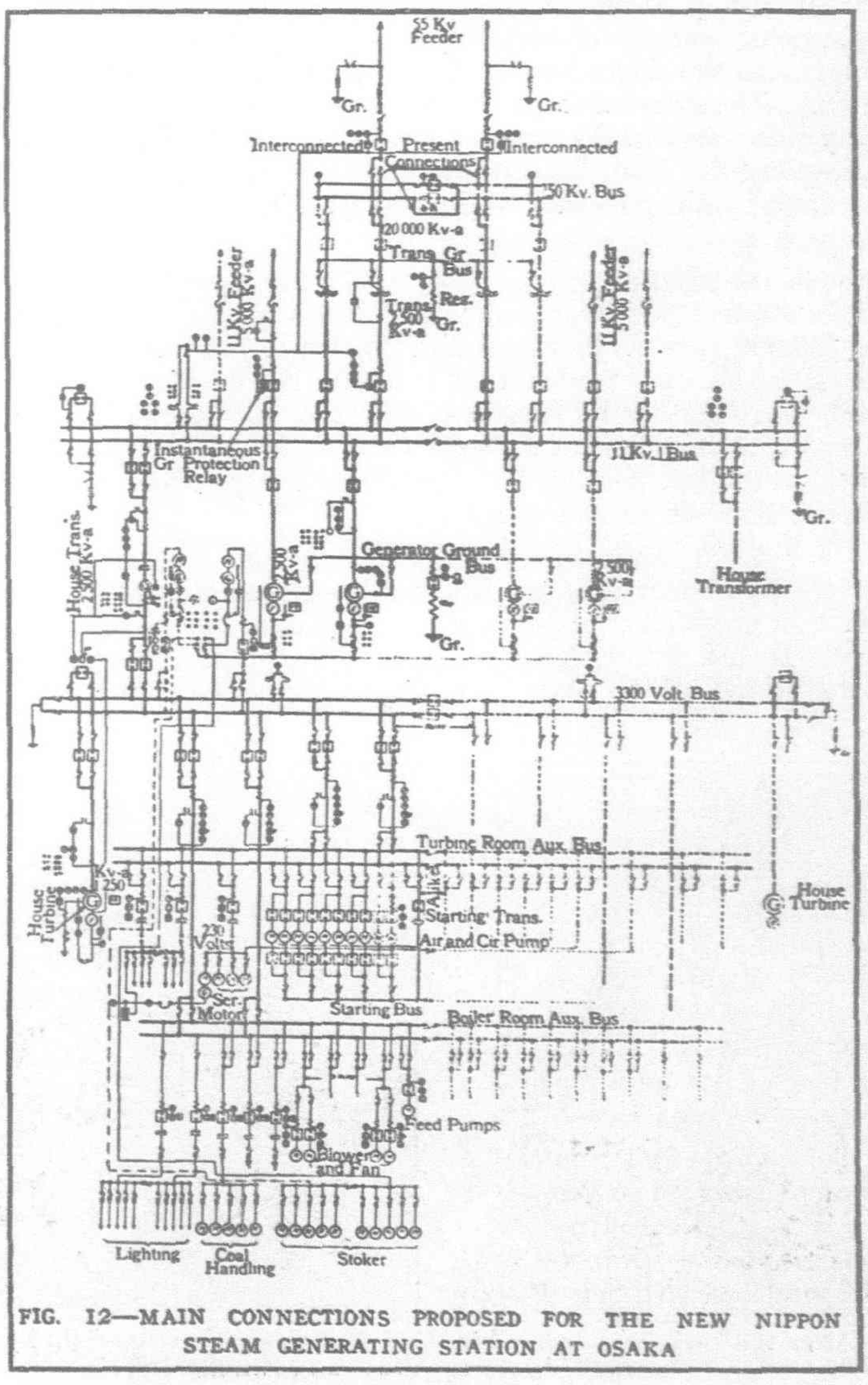
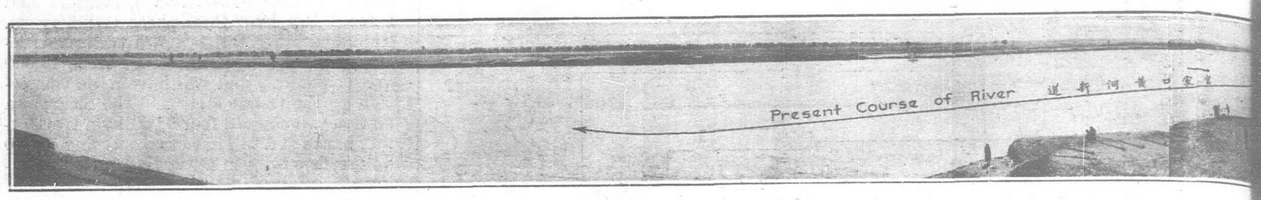


FIG. 12—MAIN CONNECTIONS PROPOSED FOR THE NEW NIPPON STEAM GENERATING STATION AT OSAKA



How Americans Can Intervene in China

A Proper Use for the Boxer Indemnity Fund

THE acceptance of the Yellow River diversion project carried out by the Asia Development Company marked the completion of a notable work whereby approximately 1,800 square miles of land were reclaimed and over a quarter million refugees enabled to return to their lands, rebuild their homes and harvest a bountiful crop planted in June of this year after the river was diverted to its proper channel. The story of this engineering feat is one which should serve as an object lesson and influence American chambers of commerce and other bodies to bring pressure to bear on their government along lines that will make for the further carrying out of similar schemes that will add more to national prestige and trade expansion than all the prevalent demands for armed intervention. The happiness of three hundred thousand persons in possession of their homes recovered to them from the bottom of a great sea of flood waters by the wizardry of modern engineering science is certainly something that overshadows in importance the depredations of a few bandit bands in the same locality. The story of this remarkable feat, which can be duplicated many times over in the same provinces, is best told in the following correspondence from Tsinan on the occasion of the acceptance of the work by the governor of Shantung:

Two years ago, in August, 1921, the Yellow River broke through its northerly dyke near Li Ching Hsien, flooding 1,800 square miles of rich farm land at the mouth of the river and rendering 300,000 persons homeless and destitute. To-day the river is switched back on a new and safer course, the flood menace at that point has completely vanished and the gladdened people are returning to their homes to begin anew a life struggle in a region to which an unkind destiny has contributed more than the usually allotted share of human sorrow.

For 4,000 years of recorded history the Yellow River has devastated human life and progress along its changeable courses over that great alluvial plain, which geologists tell us was eons ago a great Inland Sea, with the mountainous parts of Shantung merely a large island off the coast. During this time it swept its millions

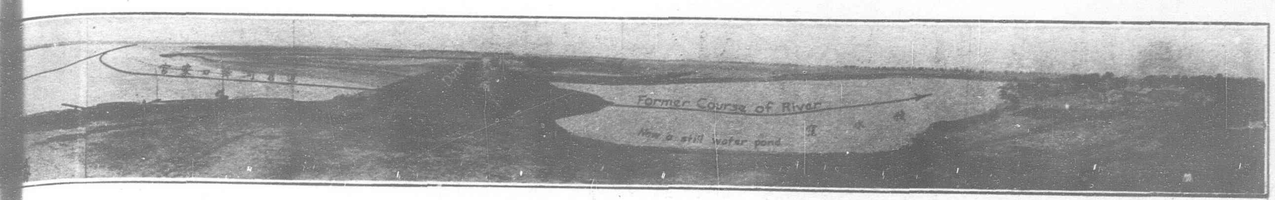
After the rocks was dumped in the dam it was made water-tight by means of kaoliang packs and earth fill

Chief Engineer L. Fred Patstone and a group of Yellow River officials inspecting the work. Wang Tze Feng, representative of the Governor, standing next to Patstone

of tons of loose soil down from the plateaux of Western China, gradually and inexorably throwing up in its path a huge silt barrier, until it filled the Inland Sea and thereby joined the Shantung island to the mainland. At the same time the stream, baulked and headed off by its own handiwork, and the mountainous country ahead, bored its way first to the north then to the south of the Shantung mountains, wherever its waters found a line of least resistance. And at each of the ten or more recorded alterations in its path it scoured the countryside with soil, ever building its almost insurmountable barriers, to thrash back again and again in desperation, devastating human life and property and laying waste great areas in yellow desolation.

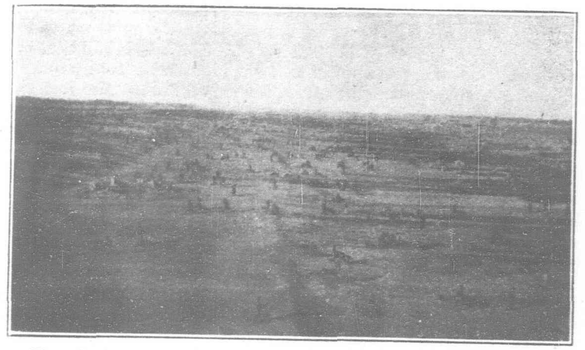
And still men fought with it. Equipped with but a meagre knowledge of hydraulic science men have grappled with this writhing creature of the western watersheds since before the dawn of history. They fought against it, with it and for it, ever digging ditches, building dykes and struggling to confine it to a reasonable course. But despite their battles, their coaxing, their primitive appeal to the gods, the water dragons and the turtles, whom they charged with breaking down the dykes, this not only great but powerful elemental thing sloughed through their dykes, filled up their ditches and laughed at their gods.

Following this 1921 break the Chinese of Shantung, led by their progressive civil governor, General Hsiung Ping-chi, were face to face with the repeated failure of the old Chinese methods and determined to call in the aid of the west to help solve their problem. Even then it was not without some doubt that they entertained tenders from a foreign firm, for there was still a root prejudice against foreign methods. It was held that foreigners had but a few decades experience to guide them, whereas China had 4,000 years and more. The foreigners would ask much money, they would throw much of it away, since they were great spenders, and in the end their efforts, experimental as far as China was concerned would, without doubt, end in no material benefits. These and similar gloomy forebodings were among some of



the things with which the courageous civil governor and his associates were faced.

But the doubters were soon due for a series of revelations. Upon examination of the tenders it was found that the foreign firms bid was more than one million dollars under than the lowest Chinese bid. The Chinese tenders were based on the old methods. The foreign on the modern. Here was astonishment. The province of Shantung would have had to pay the lowest Chinese bidder nearly three



View during excavation of leading channel, 12,550 men employed in length of one mile

million dollars, but the foreign bidder asked only one million and a half. It was a chance not to be idly dismissed. It was a chance for the people of Shantung to see what foreign, modern science could do for them and at a marvellously lower figure than by their own ways and means. On November 22, the civil governor signed a contract with the Asia Development Company, and in December of the same year, for the first time in history, foreign science was applied to China's greatest material problem.

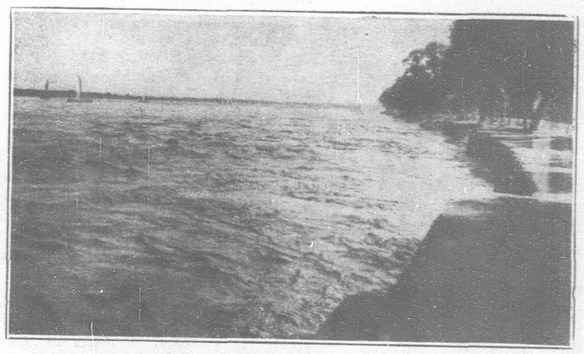
The price was not the only revelation in this contract for the Chinese marked with continued approval and pleasant astonishment the speed and workmanlike manner in which the foreign company set about its tasks. The dramatic side of the struggle was also not lost upon observers, for here was the advanced science of the west on trial for the first time in a court of conservative, skeptical judge and jurymen. Would the west succeed? Would it fail? And in the answer probably lay the destinies of China's own people, for if the west should fail then it would throw back the scientific advancement of this people possibly several decades, and at the same time, lose for the west the natural part it must play in the economic and industrial development of a great eastern nation.

But the west succeeded. Guided by modern trained engineers and aided by their appliances 25,000 laborers were thrown into the battle against this yellow destruction. Great obstructing arms, after the manner of a giant traffic policeman, were thrown across the traffic, huge channels, one a mile the other seven miles long, were cut across the country, long, impregnable dykes were stretched over the plain and without hesitation a great twisted bend of the river was eliminated, as calmly as a surgeon would remove a useless and irritating appendix. With the co-ordination that comes with applied science the progress of these colossal surgical operations moved ahead simultaneously. All the while the Yellow River dragon threw its forces into the struggle. It sentdown flood waters, and when they failed it threw into the breach great ice packs, which wrestled with and battered against the dykes and groins. But they held. The west was gaining its mastery. The mechanical pile driver plunged its 75-foot Oregon piles into the river bed, moving irresistably against the river's attacks. Behind it came the creeping barrage of 53,000 yards of rock ballast, held in a framework of piles, then came the reinforcements in the shape of kaoliang packs to defeat seepage, the river's last hope of success.

Ironically the river that fought the engineers, carried from 120 miles up stream, the rocks with which they defeated it. In the end four miles of dams and dykes threw their weight into the struggle and at a given moment the river was asked to surrender the fight by retreating through a prepared course eight miles long. On May 15, 1923, the Yellow River was let into the new coures, and accepting defeat with good grace, helped its victors by scouring a deeper and larger channel on its new journey to the sea in an old bed which it had itself long since despised and abandoned.

It was this victory that hundreds of Chinese and foreigners from many parts of Shantung and China, assembled in Tsinanfu on November 2, to celebrate.

In accepting the completed work, Civil Governor Hsiung gave high praise to the contractors for the manner in which they had conducted the work and especially for the kind treatment accorded the 25,000 laborers. He acknowledged the advantages of using machinery and modern scientific methods in controlling the Yellow River and hoped that they would be followed in the future. The Asia Development Company has completed with Chinese money the first of a great series of conservancy works which have been contracted for by Americans under loan terms which the American people apparently refuse to subscribe to. This company should be encouraged to carry on and complete its mission, and in default of loans, which seem impossible to raise, the American government should extend every assistance within its power to carry out further schemes of a similar nature by diverting the Boxer indemnity funds from educational work at this time in order to provide employment for many young engineers and bring the greatest happiness and good to the greatest majority in China. The millions of impoverished country people who are ground down by merciless taxation in order to raise the funds which go towards defraying the expenses of educating the sons of rich men in America are entitled to a share in our philanthrophy. There is no better way to bring happiness to these people than in following up the work of the Asia Development Company and providing the finances whereby this company or other successful tenderers can take up the further improvement of the Yellow and Hwai Rivers. This is the sort of intervention that will bring its own rewards and offset the pernicious activities to destroy American prestige in this country.



Yellow River in flood the early part of August 1923. Note the kaoliang packs protecting dyke

The "Lake" Monolithic House

Homes by the Mile; An American Invention Offered to Japan for Reconstruction

ONE of the most interesting plans submitted to the Japanese government for the rapid rebuilding of Tokyo and Yokohama comes from Captain Simon Lake of submarine fame who has prepared special designs of a concrete house, which he calls monolithic, for use in Japan. This invention provides for the casing, in complete slabs of specially prepared concrete, the whole side, or end or floor or roof of a house, with standardized window casings and door frames inserted. These slabs, it is claimed, are capable of withstanding jar and shock, and may be put together speedily by the aid of a huge crane, which straddling the street, drops the big slabs into place, with a minimum exertion of man power and a maximum of speed.

"Homes by Mile"

"Homes by the mile" is the term which Mr. Lake employs to describe his invention and production.

This in other words means homes built by machinery—a bigger application of the practice of the use of horsepower rather than man power. There have been ventures into the realms of ready-made houses—homes ready to set up, but these are dwarfed by the big program which Mr. Lake has worked out. In what he has done there is a wide variety of opportunity for exercise of distinctive tastes and at the same time the application of the great features of economy and speed in production.

Houses by the mile and erected at amazing speed on the Lake plan will solve the problem of Japan's immediate necessity, and wherever applied, may serve to abate the present-day high cost of building.

The process of building is decidedly novel. It is an adaption of concrete, but in its application, entirely different from anything heretofore brought out in this line. The finished product does not convey any idea of concrete construction.

If a home seeker wants a home that has the appearance of being brick construction he can have it. The stone effect is obtainable and many different varities of stucco and like appearances are easily to be had. The possibilities are almost unlimited.

Monolithic Houses

In a building program the required slabs will be cast to size. For buildings of moderate proportions, the castings will be of such size that the exterior walls will be made each in one piece. The floorings and partitions, and the roof will be made in block also.

These will be brought together and locked and when finished will form practically a monolithic structure.

A feature of the plan is standardization to such a degree that volume production will be possible. In anticipation of this, construction on an economic scale is worked out. It is intended to employ horsepower vastly more than man power.

The necessary machinery to handle the massive and heavy castings of houses of large dimensions has been planned and in the event of sizeable developments the machinery can be erected and houses can go up "in the twinkling of an eye."

A single casting will represent the labor of laying 2,000 bricks.

Statisticians have figured out that the cost of horsepower is 5 cents an hour and one horsepower is equal to eight man power. The economy of an expense of 5 cents an hour as against $6 an hour can readily be appreciated.

When Mr. Lake talks then of the erection of a seven room cottage for $3,200 and the building of even an eight room house of almost similar plans for only $2,500 the importance of the work in which he has been engaged in recent years can be better apapreciated.

Sketches prepared of various architectural styles are pleasing in appearance, and comfortable and convenient for living.

The types represent a wide variety of cottage construction, in either the country or at the shore. Shore cottages are particularly appealing, since they embody a new idea of spacious open side and roofed over upper parts, privacy being obtained by drawing large curtains.

Some styles run to the great proportions of castle-like structures, embodying new ideas that are sure to become popular. Present-day conditions, such as garage spaces are provided in the bigger structures.

Subjected to Severe Tests

As to the durability of the new construction there is little doubt in the minds of a committee of experts who prosecuted some severe official tests. New York City has a bureau of standards which has drafted requirements embodied in its bui.ding code and not long ago a delegation composed of five borough representatives met at the Lake experimental plant and tried out specimens of the concrete castings. The standard demands of the building code are ability to withstand 240 pounds pressure per square inch of surface. A cast was made on the spot and within a few minutes after the forms were removed it stood a pressure test of 350 pounds per square inch. Taking a section which had been cast some time pressure was applied and when it stood a test up to 3,100 pounds per square inch the officials were amazed. The fact that the forms can be worked so quickly after having been cast and that they improve as they age are regarded as valuable features. Ordinarily the concrete process is slower, drying out and seasoning of the common concrete construction being a requisite. Furthermore it is possible to work in the open with this new process even in zero weather without resorting to the use of salt to prevent the mixture freezing. The new practice involves a hydrating method.

Important to Quake Country

The importance of the invention to a country where earthquakes are common is better appreciated by a realization of the durability qualities already mentioned. The solid monolith construction will withstand much shaking as is further evidenced by the fact a Lake construction was loaded on an automobile truck and carried over rough highways, a distance of twenty-five miles. Once on the way the truck was forced off the highway and rolled off the hard shoulder, dropping several inches and yet the concrete structure was not damaged in the slightest degree.

Construction of this type is also fireproof, there being little or no wood in it to burn. In connection with the standardization ideal window frames instead of being of twenty or more pieces will consist of a single standard form made to fit into the opening provided in the casting.

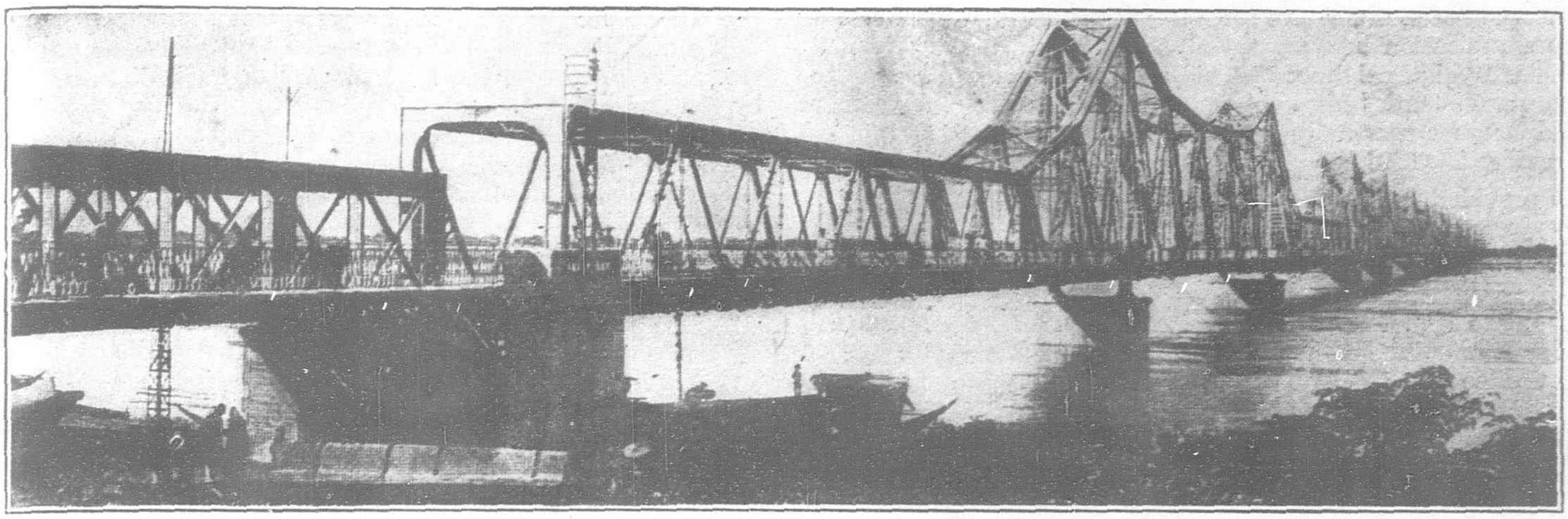
Saltpeter in China

A monopolistic agent handles the saltpeter, as well as the sulphur, output of Kiangsu, China. This representative, who maintains offices called the bureau of saltpeter and sulphur for the province of Kiangsu, is the sole agent for the sale of the production of these two chemicals in Kiangsu. The principal saltpeter producing area in Kiangsu is Soochow and surrounding districts. For rights of monopoly, the bureau pays $10,000 monthly to the Kiangsu provincial government known as "chun hsiang," or military revenue.

The annual output of saltpeter in Kiangsu is estimated at 10,000 piculs. Shanghai does not buy much of the article, the consuming centres being Changchow, Yankchow, Chinkiang and Tanyang. Main purchasers are firework manufacturers and silversmiths.

Methods of digging are crude (by hand laborers), and no machinery is used. For shipment the saltpeter is packed in sacks of rushes. The yearly quantity of salpeter produced in Chihli is in the neighborhood of 500,000 catties of only a rather crude form.

The annual output of saltpeter in Honan is estimated at 2,000,000 catties. The method of extraction in general use is placing the crude salpeter in earthern jars and pouring in water. A jar produces five or six catties of saltpeter. In the province of Kweichow there exists the Kwangih Saltpeter & Sulphur Co., whose plant and head office are in Kweiyang.



The Doumer Bridge at Hanoi before its widening

Indo-China Railways—1.

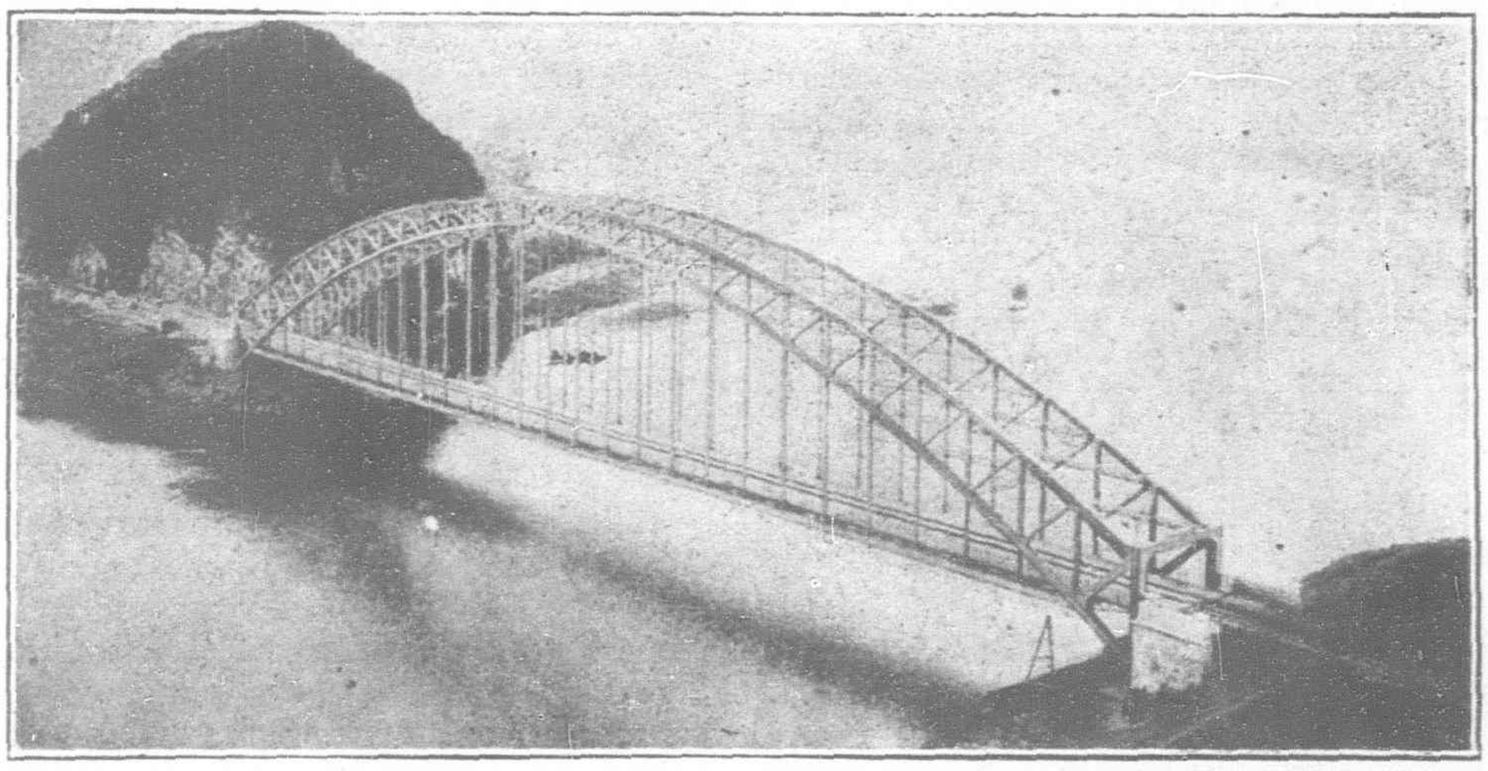
History

THE construction of the railways of Indo-China may be historically divided into three periods: (1) Prior to 1898; (2) from 1898 to 1910, during which time the program of 1898 was being realized, and, (3) since 1910, when improvements and additions are being made.

I.—Prior to 1898

A. Saigon-Mytho Railway

Towards 1880 a first proposal for railway construction in Cochin-China was made and this included a line from Saïgon to Vinh-Long with extensions to Soc-trang and to Lang-Yuyen, Chau-doc and Phom-Pen. The plans and estimates were worked out in the colony and submitted to the French admiralty, who decided that it would be better to omit for the time being the extensions and thus confine the first attempt at railway construction to a short section in a comparatively easy country, so obtaining useful experience for extensions later on. This line was built by a private company who ran it till December 1911 when the colony took it over.



525-foot Span Steel Railway Bridge over the Song-ma on the line from Hanoi to Vinh and Ben Thuy

B. Hanoi, Nam-Kwan or Kwang-si Railway

The hard and laborious campaigns for the pacification of Upper Tonkin between 1885 and 1894 necessitated the maintaining of numerous effectives in the mountain-country round about Langson and Cao-Bang, and as early as 1889 the building of a railway of 60 cm gauge was contemplated. This line was to run from Phu-Lang-Thuong (up to which point light boats could navigate all the year round from Haïphong) to Langson.

Work was started in May 1890 but all sorts of difficulties caused delay. Labor was rare and also difficult to maintain in an unhealthy country and where robber bands, safe in the mountain fastnesses of Cai-Kinh, frequently raided the camps in search of provisions and of European hostages for which they could claim ransom.

Eventually the French parliament intervened and, abandoning the system of grants from the mother-country by means of which the expenses had hitherto been met, it made more ample arrangements for the improvement of the colony to be met by an important loan.

This loan of 80,000,000 francs was authorized by the law of February 10, 1896 and was subscribed 28 times over, thus showing the value of the credit of Indo-China on its first appearance in the home market. Out of this sum 13,200,000 francs were allocated for the liquidation of other works undertaken prior to the Phu Lang Thuong-Langson railway, and 20,000,000 francs for the extension of this line from Phu-Lang-Thuong to Jia-Lam and from Langson to Dong-Dang as well as the widening of the gauge from 60 cm to 1 metre (from 1-ft. 11⅝-in. to 3-ft. 3⅜-in.).

The portion of the line between Jia-Lam and Phu-Lang-Thuong cost about 160,000 francs per mile and was carried out between 1897 and 1900. The other extension from Langson to Dong-Dang cost about 272,000 frs. per mile and was carried out between 1897 and 1901. The actual cost of converting the gauge came to about 96,000 frs per mile.

At the same time it was considered advisable to throw a railway bridge over the Red River and thus join Hanoï up to Jiam-Lam and to other projected lines. Having decided to meet the cost out of the funds of the protectorate, tenders were invited and most of the great French firms competed, the contract being eventually let to Messrs. Davdé et Pillet for the sum of 5,900,000 francs. The bridge begun early in 1898 was opened in February 1902, thus connecting Hanoï directly with the Chinese frontier by a line 105 miles long.

II.—From 1898 to 1910

The 1898 Program

While the latter part of the Kwang-Si railway was being constructed a vast project of railways was being worked out with the view of not only assuring the defence of the country, but also

of developing each of the five countries of the union and facilitating intercommunication between them as well as connecting them up with their foreign neighbors. This project was submitted to the French parliament, before whom His Excellency Governor of General Doumer personally pleaded, and was approved by the law of December 25, 1898.

It provided for the following lines :—

Names of Lines	Approximate length miles	Approximate cost francs
Hai-phong to Hanoi and Lao-kai	237	50,000,000
Hanoi to Nam-Dinh and Vinh	203	32,000,000
Turan to Hue and Kwang-Tri	109	24,000,000
Saïgon to the Khan-Koa and the Lang-Bian	404	80,000,000
Mytho to Vinh-Long and Cantho	57	10,000,000
Miles ..	1,010	196,000,000

These costs were met by means of a loan of 200,000,000 francs raised by three calls. This was found sufficient for all the proposed lines with the exception of that from Mytho to Cantho (never started) and the branch to Lang-Bian (unfinished). The line between Haïphong and Lao-kai entailed, however, heavy supplementary expenditure.

By the same law the general government was authorized to participate to the amount of 3,000,000 francs in the private company who undertook to build a railway between Lao-kai and Yunnan in China. The authorization to build this line was obtained from China in 1898 as part of the advantages guaranteed to foreign powers consequent on the war between China and Japan.

Realization of the 1898 Program

1. Railways Worked by the Colony

HANOI TO VINH, TURAN TO DONG-HA AND SAIGON TO NHATRANG

These railways were built in a similar way to that adopted for the two ends of the Langson line. The earthworks, the buildings and the laying of the rails were let by tender in lots of various sizes. All metal work was let by competition. The permanent-way and all accessories as well as the rolling-stock were ordered direct by the administration. This method has generally been found satisfactory to the administration, whenever it has been possible to furnish the contractor with fully detailed plans, and the work was in a well-known region where everything was plain sailing and labor easy to obtain, and where at the same time the staff of inspectors was ample and efficient and there was no need to rush the work.

It may be added that the cost of the completed work never surpassed the estimate by more than 25 to 33 0/0 which was a much better result than was the case in the two other systems tried, viz.: payment by schedule on the Langson railway and letting by contract on the Saïgon-Mytho and Lao-kai-Yunnantu railways.

A. Railway from Hanoï to Nam-Dinh, Ninh-Binh, Thanh-Hoa and Vinh.

This was carried out from 1901 to 1905.

From every point of view—planning, construction, opening, country run through and running—it may be divided into three sections :

(1) From Hanoï to slightly beyond Ninh-Binh (73 miles) in the Tonkin delta ;

(2) From this point to Song-Ma (81 miles) in the rolling and but slightly cultivated country between Tonkin and North Annam ;

(3) From Song-Ma to Vinh (Benthuy) a distance of 49 miles joining the two centre of production in North-Annam—the deltas of the Song-Ma (Thanh-Hoa) and the Song-Ka (Vinh).

In accordance with the law authorizing the loan decrees were issued as follows :

On April 20, 1890 for the two end sections, and on December 7, 1900 for the intermediate link which was delayed owing to there being a choice of plans on the Tonkin-Annam frontier and to the difficult work necessitated by the bridging of the Song-Ma river.

On each of these sections the earthworks, ballasting and laying of the permanent way were let in one contract, and the important steel bridges in three separate tenders.

The Hanoï to Ninh-Binh section was started on January 9, 1903 and in December of the same year trains ran as far as the Song-Ma. The bridge over this river with a span of 525-ft. was completed by the end of 1904.

The completion of the line was delayed by extraordinary floods which submerged it in several places. This necessitated the raising of the road-bed and other supplementary works including the facing of some of the embankments with stone at the various weak spots. It was possible, however, to open the line on March 17, 1905 and it has been running without a hitch ever since.

Including all this extra work this railway cost 41,000,000 francs as against the 32,000,000 estimated.

B. Railway from Turan to Hue, Kwang-tri and Dhong-Ha.

This line, like the one just described, forms part of the great Trans-Indo-China trunk railway as proposed in 1898.

The first part built was from Turan to Hue on account of the political necessity of connecting up the capital of Annam with a port easily accessible to boats plying on the surrounding seas. The second part from Hue to Dong-ha was built solely as an eventual part of the great trunk railway.

The earthworks, etc., of the Turan-Hue section were at first carried out by contract and eventually by schedule. This was completed by the end of 1905 and the permanent way in 1906, the line being opened on December 15 of the same year.

The second section from Hue to Kwang-tri was authorized by decree on January 27, 1905 and was opened during 1908 in four successive parts.

The running of this line has always been at a loss which will probably continue until it has been connected up to the other lines north and south of it. At the same time it is liable to frequent interruptions owing to typhoons and floods.

Its total cost including everything was 34,500,000 francs being 7,500,000 over the estimate, of which 6,900,000 frs. were incurred on the Turan-Hue section.

C. Railway from Saïgon to Khanh-Hoa.

Two projects were considered each having a common portion of 82 miles between Saïgon and Tan-Linh, running thence either along the coast with a branch to Langbian or inland to Djiring and direct to Langbian.

The first named project was eventually adopted and work on the first 82 miles was authorized by the decree of June 17, 1900, but progress was hindered by numerous difficulties, not the least of which was the insufficiency and instability of labor, and it was not till the beginning of 1908 that this section was opened.

A decree dated January 27, 1905 authorized the second section, but here again the same difficulties were met with and it was only in 1913 that this part was opened.

The total cost of the line from Saïgon to Khan-hoa amounted to 73,000,000 francs.

2. Railway Worked by the Indo-China and Yunnan Railway Company.

The part of this railway running from Haï-phong to Lao-kai and lying wholly in Tonkin was constructed by the colonial government who, in accordance with the agreement of 1901, was to hand it over all complete to the private company.

Where running through the delta between Haï-phong and Vietri this line was certain of a heavy traffic, but beyond it was merely a link with Yunnan.

The decree authorizing the first named section was dated April 21, 1899 and that for the second section December 7, 1900.

The work on the first section were carried out between 1900 and 1903 without any difficulty and plenty of efficient labor was available. The line was handed over to the Company and opened between Haï-phong and Jia-Lam in April 1903, and between Jia-Lam and Vietri in November of the same year.

On the second section between Yen-Bai and Lao-kai, passing through a desert and unhealthy region, it was very difficult to obtain labor so that it was in May 1906 only when the line was handed over to the Company and even then the last 95 miles before Lao-kai were not complete.

The line from Lao-kai to Yunnan-fu was constructed and equipped by the Company, the rôle of the colony being confined to a subsidy of 12,500,000 francs and an option of purchase for 3,000,000 francs during 75 years.

The route finally adopted follows the valley of the Nam-Ti and reaches Yunnan-fu by the valleys of the Pa-Ta-Ho and the Tatshen-Ho. This was through a very difficult country and necessitated much bridging, tunelling, etc.

Recruiting the coolies, transporting material and provisions, arranging for the sanitation of the camps and protecting them against the raids of Chinese robbers were each and all difficult problems for the contractor. To this were added the technical difficulties of the line itself ; 3.422 viaducts, bridges and culverts—an average of 11.7 per mile—of a total length of over three miles, and 155 tunnels totalling about 11½ miles in length. The steepest gradient was in 40 and the radius of the sharpest curve about five chains.

Delayed by frequent difficulties, the line was opened in successive sections between June 15, 1908 and April 1, 1910, on which latter date the first locomotive steamed into Yunnan-fu.

The traffic on this line has rapidly increased in spite of the frequent yearly interruptions in the broken ground of the Nam-ti and Pa-Ta-Ho valleys, where important supplementary works had to be carried out, on account of frequent land-slides during the rainy season.

Owing to all these difficulties the actual cost of the line largely exceeded the estimate of 94,000,000 francs, and was fixed by an arbitral commission in 1908 at the sum of 165,000,000. The colony was therefore obliged to furnish a new subsidy of 53,000,000 francs, which it raised by a loan authorized by the law of March 14, 1909.

III.—From 1910 to 1920

By 1911 the various railways authorized by the 1898 program were complete, except :

The Saïgon and Khan-hoa Railway which was still in progress, and the Saïgon, Mytho and Cantho Railway, which had not been begun.

Furthermore, towards the close of 1910 the credits arising from the loan of 200,000,000 francs were exhausted, so that a new loan of 90,000,000 was authorized by the law of December 26, 1912, to meet the cost of various works for the economic development of the colony, and included 22,600,000 francs for the completion of the reduced program of 1898, and 28,300,000 for planning and constructing the following new railways :

(1) The first portion of the Vinh and Dong-ha railway, eventually to form part of the Trans-Indo-China Trunk line, and

(2) A line from Dong-Dang to Na-Sham forming an extension of the already existing Kwang-Si railway.

The completion of the 1898 program included not only improvements on existing lines, but also the completion of the Saïgon and Khan-hoa railway with a branch line running towards the Lang-bian plateau, all of which was carried out between 1912 and 1914.

Plans for the Vinh and Dong-ha line had been prepared in 1897 for the 1898 program, and in 1912 were again taken up with the result that a decree, dated September 11, 1913, authorized a start on the first section between Vinh and Tanap. A subsequent decree, dated June 26, 1915, sanctioned a start being made on the portion between Dong-Ha and the river Nganson but the immense difficulty of obtaining labor and the general rise of prices due to the war paralysed the work so that by the end of 1919 the situation on the whole of this railway was as follows. Between Vinh and Tanap (5½ miles) the earth works, and the masonry of the large bridges and buildings were finished. On the second and third sections (82 and 45 miles) plans were completed and the line staked out.

The extension towards Na-Sham of the Kwang-Si railway was based on the idea of striking the Song-Ky-Kung at a point accessible to light craft at all times of the year. The cost was estimated at 1,800,000 francs. The work was authorized by the decree of April 16, 1913, and in 1919 everything was ready for the laying of the permanent-way ; this however, was supplied only after much delay and the section from Dong-Dang to Na-Sham was opened for traffic in November 1921. The total cost, including sundry improvements, amounted to 3,400,000 francs ; and it may be said that this large excess over the estimate was largely due to the high price of the piastre from 1919 to 1921.

IV.—Present Situation

No new railway has been opened since that between Dong-Dang and Na-Sham, but the extension of the existing railway system is one of the first items on the program of the government, especially the completion of the Trans-Indo-China main-line running from north to south and connecting up all the local capitals, and the building of new lines to open up Laos.

The construction of the Vinh and Dong-Ha section has been vigorously taken up and it is hoped that Hanoï and Hue will be connected up by railway by 1925. At the same time plans for lines between Hue, Nha-trang and Saïgon as well as from Saïgon to Pnom-Penh and the Siamese frontier have been started and a special commission composed of French specialists has been already engaged for some months in laying this out, while another commission is engaged on the plans of a railway from the Krong-pha to Saïgon line (or from some point on the Trans-Indo-China main-line) to Dalat, the important hill-station on the healthy and picturesque Langbian plateau. This will be a mountain railway from Dalat to Krong-pha, the present terminus of the Langbian branch.

Before the end of the year a start will be made on the plans of a railway in Northern Annam to connect Laos with the Gulf of Tonkin and passing through Tanap and Tah Kek.

Finally plans for the extension of the Saïgon to Mytho line towards Soc-trang and Bac-lieu will certainly shortly be made out.

(*To be continued in January.*)

Woolen Industry in China

Steady progress is being made by the native woolen industry in Tientsin, mills now in operation manufacturing nearly all products obtainable anywhere. Incidentally Hugo Stinnes the German magnate is, according to rumor, about to establish a woolen manufacturing plant there also.

Among the commodities made now by Chinese native factories are shirts, trousers, cloth, hosiery, knitting thread, scarfs, blankets, gloves, yarn, cloth rugs and carpets. About 15 mills are in operation.

The Chung Hua Co., at 160 Yung Kong Li, East Seward Road, Shanghai, manufactures woolen shirts and trousers. At Harbin, an industrial works for the poor, makes woolen cloth, hosiery and other knit goods. It has 25 woolen cloth weaving machines, knitting machines, and sewing machines. The Kai Yuen woolen and carpet factory is located at 81-83 Lan-man Hutung, Peking.

The products of the Li Hsin Textile Mill, which has its office and mill in Ningpo, are woolen scarfs, hats, etc. The Manchu-Mongol Woolen Manufacturing Co., in Mukden, is a Japanese concern with an annual output of 80,000 blankets, valued at Yen 11,000,000 and 150,000 yards of cloth, valued at Yen 850,000.

The Pu Li woolen mills are at Tsunghochen, (Chingho) on the Peking-Kalgan railway, and are operated by the board of military affairs of the Chinese army. These mills were established to make woolens for heavy winter uniforms, and goods, weighing three pounds to the yard, for overcoats, and still heavier for blankets. According to the latest report, the principal products were plain and colored felts and carpets.

Liu Cheng Li and Liang Wenchow established the Shih Hsing Woolen Weaving Co., Ltd., in Taiyuan-fu, Shansi, with woolen gloves, hosiery, etc., as its products. The Jeh Yung Woolen Manufacturing Co., of Chunkiang, Szechuan, and the Tsing Woolen Weaving Factory of Tsining, Shantung province, manufacture woolen cloth.

The Wuchai Woolen Weaving Works, at Wuchai, Shanse, manufactures blankets, scarfs, gloves, shirts and hosiery. Woolen and yarn cloth are the products of the Yu Hua Woolen Weaving Co. The China First Woolen Spinning and Weaving factory, near the Zeh Hui bridge, Shanghai, produces woolen goods of good quality. It has a special product in a kind of quilt to replace the usual cotton covering. Woolen yarns are produced by the Lung Hwa Woolen Yarn factory, Wei Yih Woolen Yarn factory and the Wei Yih Woolen Yarn Manufacturing Co. All are in Shanghai.

The Tapioca Industry in Java

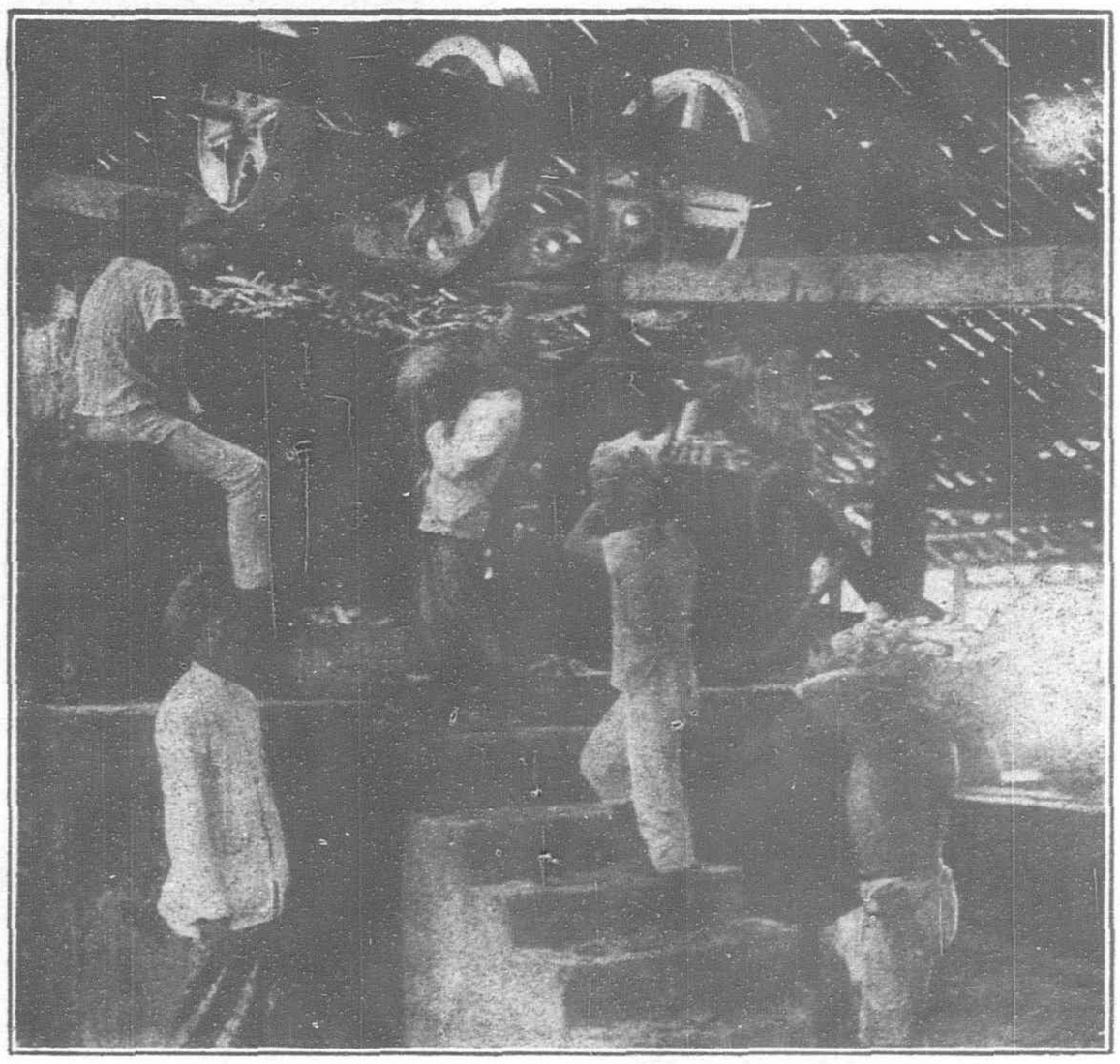
CASSAVA, or tapioca, as it is generally known, from which plant various kinds of foodstuff are obtained, came originally from Brazil, from which country it has spread over all the tropics and sub-tropics. In a wild state, the plant is frequently found in the forests of South America, and it is mostly due to the Portuguese that it has been transplanted to other parts of the world. With a few exceptions, due to unfavorable climate, tapioca is now cultivated in every country between the Latitudes of 30° N. and30° S.

Concerning the origin of the cassava raised in Java and other islands of the Dutch East Indies only very little information is available. It has been recorded that about the year 1850 the plant had been found in Java from time immemorial and that it had probably been imported from China. At that time, however, its cultivation was only carried on in special districts of the island, principally in the residency of Bantam (West Java). During later years special attention has been paid to the extension of the cultivation and the preparation of tapioca products.

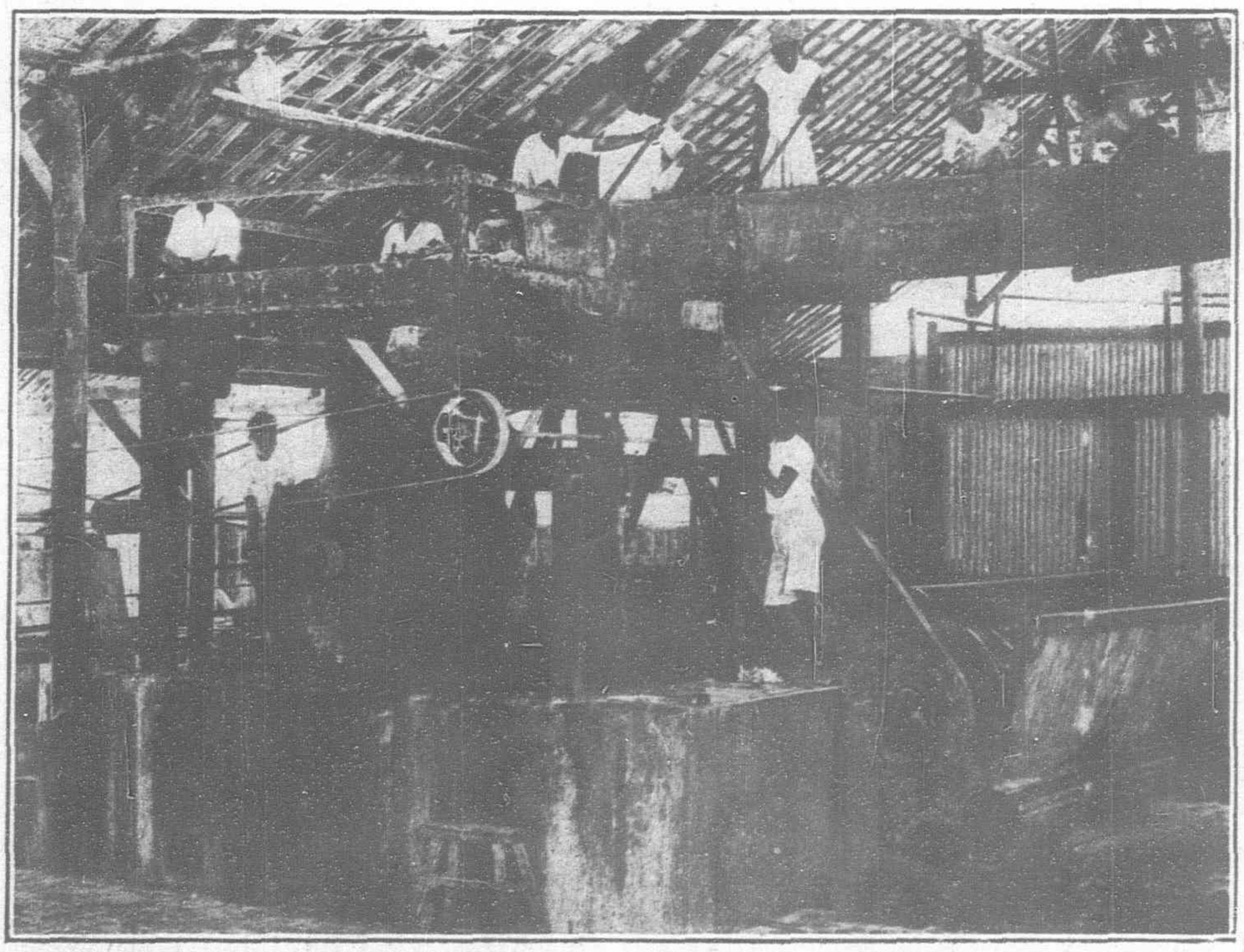
The food value of the tuberous roots of the plant (which are like carrots, tapering cylinders, 12 to 20 inches long) has long been known, and in some parts of the world, more especially in South America and West Africa, the tapioca root is in many regions for the native population what the potato is to many civilized peoples, i.e., an indispensable article of diet, a prime necessity of life.

In European countries the best known product of the tapioca plant is the flour or starch, but for a number of years past, by means of a sort of stiffening process in the starch factories, a number of products have also been prepared from the wet flour, which are put on the market under the names of tapioca flake, siftings, pearl, seeds, etc., and which are largely used for industrial purposes, while the roots, after being cut into pieces and dried, as well as the waste obtained in the manufacture of the flour, are for the most part used in the preparation of feeding-stuff for live-stock.

For a long time the cultivation of the cassava was principally limited to West Java, but since the beginning of this century it has spread also over Central and East Java. Thanks to the erection of a great number of factories of various capacities producing tapioca flour and other products, it has grown to be a very important industry, especially in the district of Kediri, where there are now factories in which over 1,000 laborers are employed. The Preanger district, also, is to-day an active centre of the industry, and most of the factories here are owned by Chinese and native capitalists. Besides by the factories themselves, a great quantity of tapioca flour is made by the natives in their own primitive way, and the product thus produced is called kampong (village) flour, in order that it may be distinguished from that made in the factories under European or Chinese management. It is not uncommon to find the natives selling their flour to Chinese millers who carry out the work of washing, sifting and drying the product.



Bringing the peeled cassava roots to a trough above the grating machine

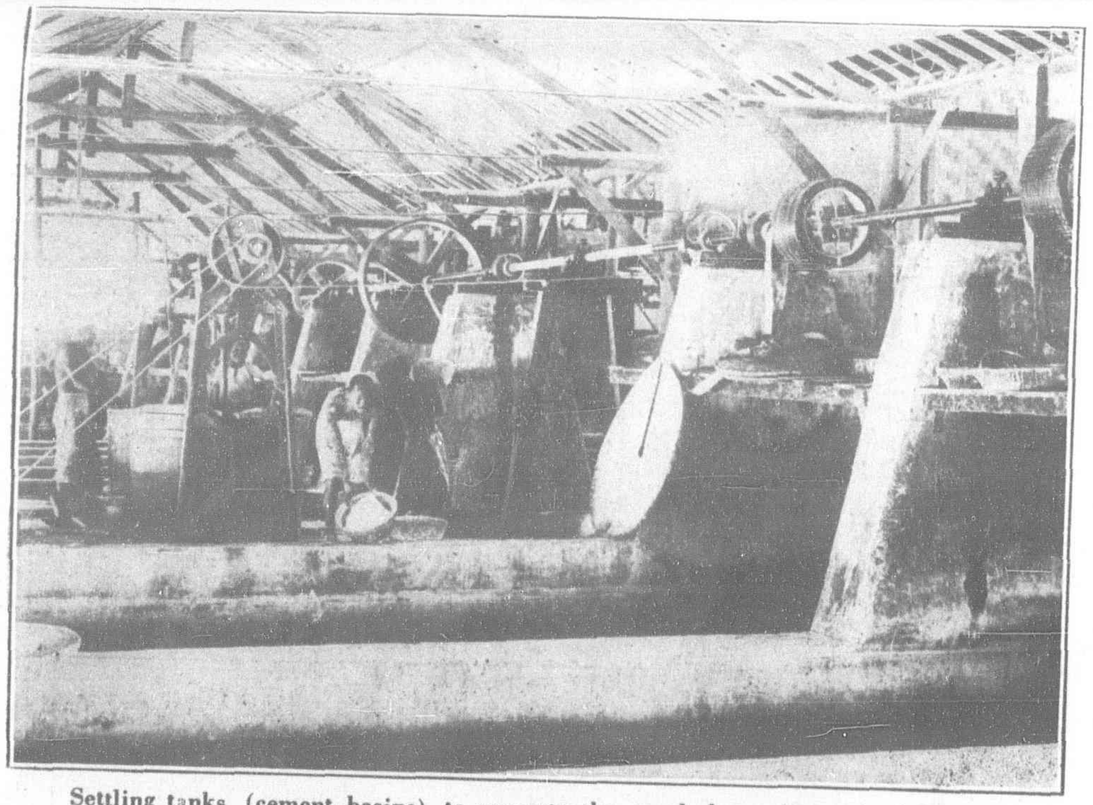


Grating machine or pulper and re-crusher (on the cement platform). After leaving these machines, the pulp is washed away to the cylinder sieve (down to the right).

The many existing varieties of the cassava (technical name: Manihot utilissima, Pohl.) are commonly classified as bitter and sweet, and these are also frequently regarded as two separate species. The specific differences between the two, however, are very slight and some botanists consider it more than probable that the sweet cassava is only a variety of the bitter, derived from centuries of cultivation under the most varying conditions.

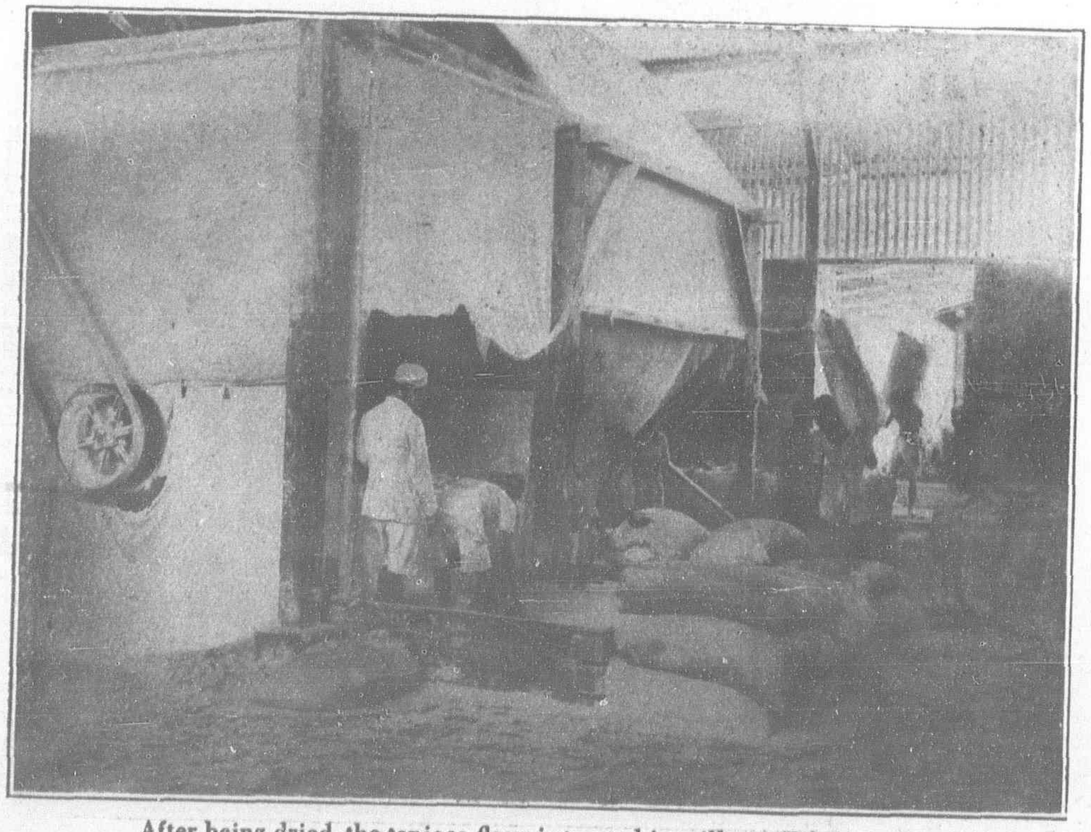
In Java, the number of forms and varieties of cassava is very great, while the characteristics, with respect to duration of growth as well as power of production, differ considerably. Although the native farmer has special names for most of these varieties, these give absolutely no assurance of distinguishing them, since the names are subject to local changes, and besides they are apt to be rather arbitrary.

In general it can be said that the varieties with dark-colored bark have a greater productiveness than those which have a light-green bark. Some varieties yield a considerable crop already at an age of from five to six months, in others, on the contrary, the tuberous formation first begins at the age of about eight months or later. In some varieties the roots are bitter, hard and unpleasant in taste, in others sweet and tender. In the preparation of flour, etc., this factor is, of course, of little importance, as in this case only the standard of starch is considered, which, next to the yield, determines the value of the variety. Various tests have demonstrated that not only does the productivity of the different kinds vary considerably, but that the standard

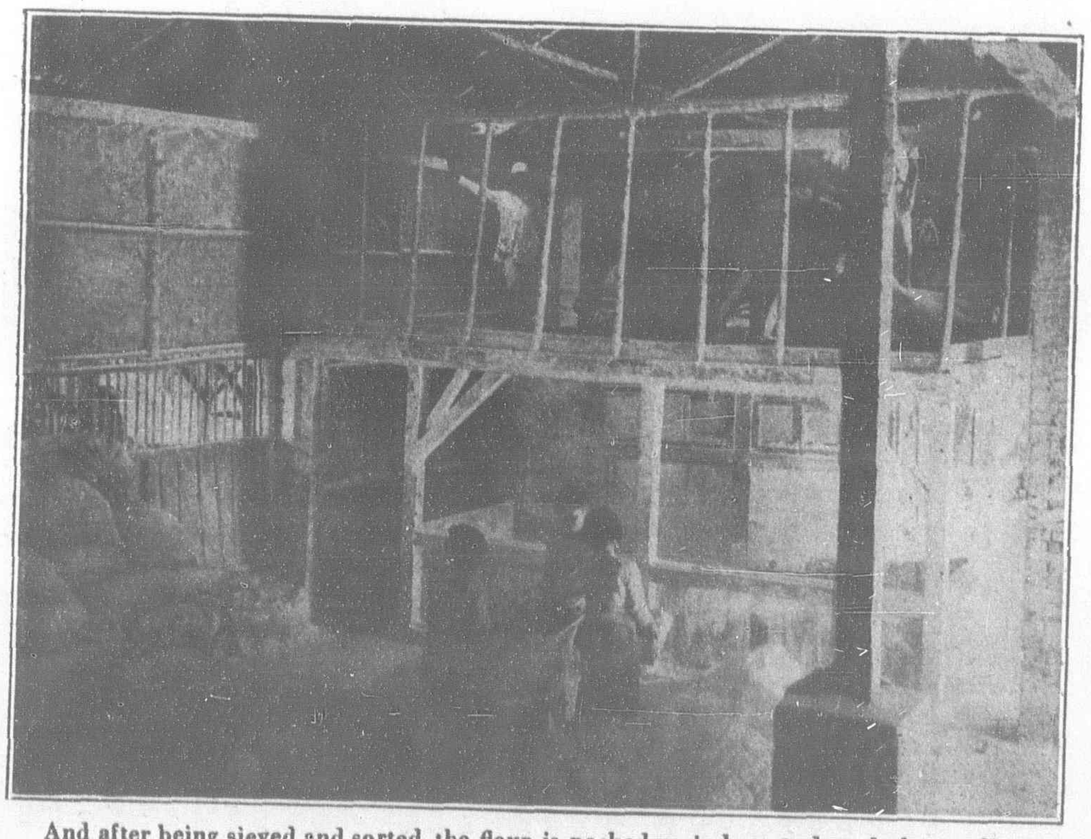


Settling tanks (cement basins) to separate the starch from the strained liquid or starch milk, after settling in these basins the starch is transported to stirring tubs—shown on left of picture.

Drying tapioca flour in the sun.



After being dried, the tapioca flour is treated in mills or disintegrators.



And after being sieved and sorted the flour is packed up in bags and ready for market.

of the starch is not always alike; in cultivation, therefore, it is of the utmost importance to pay attention to this factor.

As to soil, the cassava plant makes few important demands; the best results are usually obtained from soil with a moderately loose structure. However, the plant will generally thrive well in a more or less stubborn and barren ground, providing the soil is sufficiently porous, as cassava cannot endure any standing water. It is true that in soil of great fertility the plant grows luxuriantly, often forming much leaf and thick stalks, mostly, however; at the expense of the root production.

The harvest time of cassava, in contrast with that of other crops (rice, maize, etc.) is not narrowly limited; the longer the roots are allowed to develop, the more produce is obtained in proportion. There is a time, however, in which the roots contain their maximum amount of starch, and although after this time the volume of the tubers increase, this takes place at the expense of the starch content.

The yield of the plants varies considerably in Java as well as in various other countries, and depends principally on the variety cultivated, but also on the composition of the soii, on the climate and the tilling of the ground. In plantings on level unirrigated fields in the Preanger district, using the varieties generally planted by the native population, a yield of from five to ten tons of unpeeled roots per acre can be counted on, in case the crop is harvested at the end of one year. In the Kediri district it appears that from seven to ten tons of unpeeled roots per acre are obtained, although it is known that good varieties can produce much more, even up to seventeen tons.

With a minimum production of about five tons of roots per acre, therefore, it is possible to count on a production of from 1 to 1.3 tons of flour per acre. Expenses for planting and upkeep are small, so that it is not surprising that wherever suitable grounds and good, pure water are available, as for example in thePreanger district, special attention is paid to cassava culture and the manufacture of tapioca products.

The preparation of tapioca flour is based on opening the cell walls of the roots and so liberating the starch. This can take place under two entirely different methods, i.e., *mechanically* by means of grating, or *biologically* as the result of bacterial action. In Java, however, the former method is made use of exclusively.

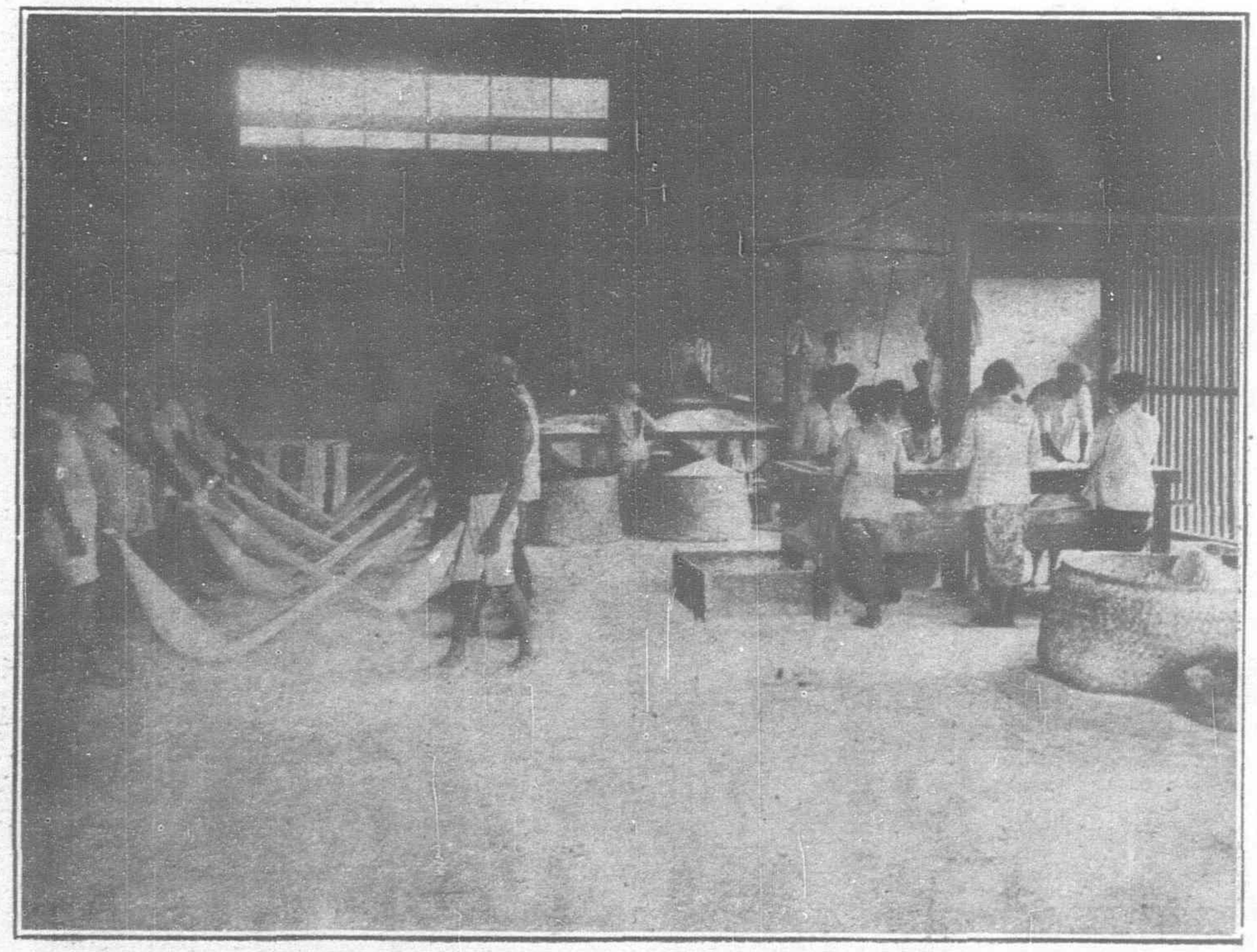
Sorting "flake" and "siftings" by means of sieves. Tho women on the left are preparing flake tapioca in iron pans, which are immersed side by side in a row in a sort of furnace, heated separately by a small fire on the outside of the structure.

Speaking generally, the process of preparing the product followed in the "kampongs" (native villages) is identical to that of the factories to a certain point, but as already mentioned above, it is carried out in a most primitive way, whilst in the factories power-driven modern machinery is used. In either case, however, the first essential to success is a plentiful supply of pure, soft water, and that the roots be freshly dug.

As a rule, the roots are peeled by the natives before being delivered to the factory. Only when a factory has its own plantations and the peeling is difficult on account of lack of laborers, are the roots sometimes grated unpeeled. This method, however, requires greater running expenses, so that it is usually avoided, the more so because it is then more difficult to obtain a perfectly white flour, a factor which must be carefully taken into consideration, as the market value of the product depends mainly on the pure white color.

There are several types of machines employed for the preparation of tapioca flour, and, speaking generally, all the machinery used in a potato starch factory can be employed for cassava milling, although slight modifications in the character of the grating or pulping machine and of the sieves is necessary: cassava roots being more fibrous than potatoes and the starch grains smaller.

In the most elementary case, the native flour manufacturer has little else than a grater, constructed from a piece of tin, in which a number of holes have been made; the upstanding edges of these holes then form the grater. Sometimes the native graters are so constructed that small pieces of copper or iron wire are stuck close together at equal distances into a small board. It goes without saying that with these primitive tools much starch remains in the pulp, i.e., in the form of unopened cells, and that moreover it is possible to manufacture only small quantities of cassava per day. A relatively great improvement, as far as capacity is concerned, is the mill- or tread-grater, used by the natives in the Kediri district. This consists of a hollow cylinder, attached by wooden spokes to a centre axle, in the



Preparing pearl tapioca: showing the primitive methods employed in shaking the tapioca in a kind of sieve to obtain the pearl.

same way as in a cart wheel. The cover of the cylinder is made by strips of tin, which are provided with teeth in the same way as the tin grater described above. The wheel is set in motion by a tread arrangement whereby the pedals constructed on both sides of the centre axle are turned around by the laborer's feet. At the same time he presses the cassava root against the grater, while a stream of water out of a reservoir placed above the arrangement runs the pulp into a basin or trough underneath the wheel. To prevent spashing during the work, most of the grater cylinder is provided with a wooden cover.

Here also, as in the case of the hand graters, a very incomplete opening of the cells takes place, so that much starch is left behind in the pulp.

The grating machine or pulper used in tapioca mills may consist of a revolving box or drum, running at high speed and covered with perforated sheet iron. As a rule, under the box is found a so-called recrusher to complete the disintegration of the cells and ensure the maximum yield of starch. No matter how thoroughly the roots are grated, however, it has been found that it is impossible to draw all the starch from the cells with a single operation, so that from 10 to 15 per cent. of it remains behind in the pulp. In order to save a part of this starch also (which, however, gives an inferior quality), in some factories the pulp is treated once more in a so-called pulp mill. As this necessitates a special sieve, however, and as an installation of this kind costs considerably and requires a great deal of motive power, this reworking is omitted in most factories.

After leaving the grating machine, the pulp is washed away to the straining machines, in which the starch must be separated from the cell walls, unopened cells, etc. The mesh width of the sieves is therefore chosen in such a way that the starch grains are able to pass through the meshes, but not the other parts of the pulp.

As a rule, two or three sieves of different meshes are used to facilitate the process. That which remains in the sieves is called "ampas" (waste).

Of the three types generally used in Java, namely: cylinder sieves, fixed sieves and shake sieves, the first seem to give the most satisfaction. The shake sieves must be repeatedly repaired and besides often hinder the work because the sieve openings become stopped up. The fixed sieves, which are mostly used in factories where only a limited amount of space is available, are very good to use for separating the starch from the fibre, but are less satisfactory for refining the starch. They have the advantage, however, of being cheap and needing little repairing.

The flat brush washing sieve is used only in a few factories in Java. In this the pulp comes into the middle of the sieve, where brushes which wash the pulp and at the same time keep the sieve holes open, gradually push it in a spiral line to the circumference; the pulp in the meantime being continually sprinkled with numerous watersprays from an annular sprinking pipe. The residue which comes to the edge of the sieve is swept into a traphole by the outer brushes. With these machines, which have a steady motion, the work is under good control, as the process remains entirely visible throughout.

Upon the care bestowed on the sieving depends the yield of first and second quality flour. Sieves which work insufficiently, not only give flour which still contains fibre residue and becomes gray when dried, but also hinder the settling process, so that much starch lands in the waste.

In order to separate the starch from the strained liquid, the starch milk is carried off to the settling tanks, troughs or tables. The first are by far the most in use. They consist of cemented basins, furnished with an arrangement by which, after the starch has settled, the overstanding water can be run off as completely as possible. As this water still remains a slight amount of starch which one does not wish to lose, it is allowed to run into the outer basins, where it can once more quietly settle. This sediment, together with the dirty material mentioned later, is manufactured as an afterproduct.

After settling in the basins, the starch which is cut out in blocks with a wooden spade, is least clean on the upper and lower sides. The blocks are therefore scraped off above and below and the scrapings collected separately in order to be manufactured as an afterproduct together with the sediment from the outer basins.

The starch is next transported to stirring-tubs, in which by means of a stirring apparatus (consisting of an axle with two spokes), and with the addition of as little water as possible, it is stirred into a thick pulp. As soon as the flour is mixed with the water into a homogeneous mass, the broth is again carried to the settling tanks to resettle, after which the standing water is again allowed to run off. In this way, two qualities are obtained, each of which must be treated further separately.

To hasten the settling process a little sulphuric acid is sometimes added.

Instead of letting the pulp from the stirring-tubs settle, factories with modern equipment generally use the centrifugal process. The aim of this operation is to remove the water as much as possible and to sooner dry the flour. Not only does the centrifugal method act more quickly, but a better separation of the qualities of flour is also obtained, while the product separated contains less water (about 40 per cent.) than the flour obtained by settling (about 50 per cent.), which naturally is an advantage in the drying.

As a rule, the wet flour is dried in the sun. Only under unfavorable conditions (cloudy sky, rain) is use made of the drying apparatus designed for this purpose. When the flour is dried in the sun, it is spread out on flat baskets, made of bamboo or tinplate, which are set on bamboo scaffolds, and as the drying necessitates, made fine by hand. In large factories, and where hand labor is scarce, mechanical drying is used exclusively. This method requires much more care, especially since in the sun drying process the flour is also bleached, which is not the case with mechanical drying. Before being dried, the flour blocks are broken into small pieces. This is done so as to give the flour a greater surface area and so hasten the drying process, and also to prevent the forming of small pieces or so-called grits.

In the factories in Java the most varying systems of drying apparatus are used. The simplest are those which consist of galvanized iron plates under which a small fire is built. During the process of drying the flour is continually stirred with a spade. There is also drying apparatus made according to the tunnel system and a kind with moving strips of cloth, in which a steam-heated element is placed between the strips, which are placed horizontally and which run on both sides over movable rollers. Some of the advantages of these machines are: no danger of the flour turning yellow as this does not come into contact with hot metal plates; the small amount of space required; quick drying; good observation of the work and small cost of operation. Moreover the arrangement needs no continuous supervision, as the wet flour is brought automatically from above and the dry product is carried off in the same way.

After being dried, the flour is worked in mills of disintegrators; then, after being sorted and strained through a sieve, it is ready to be placed on the market.

In factories where unpeeled roots are made into flour, it seems to be very difficult to obtain a product which is entirely free form bits of peeling, and here the flour is generally bleached. As a bleaching medium, sulphuric acid is used, or sometimes natrium bisulphate. Tapioca flour bleached in this way, however, begins to discolor somewhat after a few months.

Tapioca flour intended for export, is packed in gunny bags holding about 75 to 80 kilos.

The chief consumers of the article are Great Britain and the U.S., though important quantities are also shipped to France, Holland, Singapore, Hongkong, etc.

Cassava starch can be utilized for almost all the purposes for which other starches are employed. In addition to its emplyment in the manufacture of alcohol and glucose, it is used for laundry purposes, for sizing yarns and fabrics and for the manufacture of dextrin or British gum. For laundry purposes the starch is inferior to rice starch, but it is said to be much better than either maize starch or potato starch, giving a smoother surface and a finer gloss.

Cassava starch is stated to be inferior to other kinds of starch for sizing cotton yarn, as it yields a paste of somewhat feeble adhesive properties. For medium and heavy sizing it may be mixed with some other material with stronger adhesive power, such as wheat flour or maize starch.

The fine white color of the better quality of tapioca flour, as well as its freedom from odor, makes it more practicable, however, than potato flour for use in many industries, i.e., in the manufacture of biscuits, etc.

For a number of years past, in many cassava flour factories in Java much attention has been paid to the preparation of tapioca flake and pearl, which sometimes find a better market. These cassava products are being made by means of a stiffening process while the flour is still damp. Only pure white flour of first quality is used for their manufacture, as a yellowish product is less in demand.

For the making of flake tapioca the damp flour is spread in thin layers on large rectangular tables, three sides of which have raised edges. The mass is then rolled by wooden rollers, pressing the flour grains together into flat blocks. The latter are taken out and put into round iron or copper pans, about 24 inches in diameter. These pans are placed in one or more rows and heated either over a smouldering fire or, in the case of large factories, by steam under pressure.

After a few minutes the starch grains begin to adhere to the metal; they are loosened with a spatula to prevent sticking and to hasten the drying. Finally they gelatinise and take on the semi-vitreous appearance which characterises this product. After being cooled off the process is completed by drying in the sun, in order to become bleached.

The pieces of flake, which naturally are of unequal dimensions, are ultimately sifted into various sizes, while the largest pieces are crushed in mills designed for this purpose. The very finest grains come upon the market as "siftings."

Flake and siftings are packed in the same way as the flour, though some importers want it packed in wooden barrels for better protection of the contents against moisture during the voyage. This packing also protects the flake better against crumbling.

The mechanical preparation of pearl tapioca takes place by pressing the damp flour through a perforated plate. In this way strings are formed, somewhat resembling vermicelli. These strings fall on heated plates (the heat being produced by steam), which are mechanically held in a rocking motion. The granules then roll over and over each other and finally gelatinise in the form of pearls. The process is complete as soon as the pellets are hard enough, which the experienced worker can tell from the sound they make when rolled.

In small factories in Java the pearls are still prepared primitively by rolling the damp flour grains in cotton bags. This method is demonstrated by the annexed photograph.

As with the flake, the tapioca pearls are also sifted into various sizes, whereby three or more kinds are obtained, which are known under different names (bullet, medium, small pearl, etc.) on the market.

Another article made by the cassava mills forms the "ampas" or factory waste, already briefly mentioned above. It consist of the pulp retained by the sieves, and in the wet state this material contains about 90 per cent. water and for the rest cell walls, unopened cells, etc. After being dried, it is exported either in pieces or ground.

Few accurate tests of the feeding value of cassava waste have been recorded, but in view of its excellent mechanical condition and its high nutritive value it seems to be chiefly used in the cattlefood industry. Like the roots, the waste forming essentially a carbohydrate food, it is necessary to mix it with materials containing fat and proteins, and should it be poor in lime, phosphate of lime should be added.

Until the first years of the present century, the Straits Settlements practically monopolized the world's trade in tapioca products. Brazil and Reunion, it is true, produced considerable quantities, but the exports from these regions were of comparatively little importance.

As a result of the increasing competition in the world's markets and in consequence of the rubber boom during 1910, when great stretches of land were withdrawn from the growing of cassava, the production of the Malay archipelago sensibly decreased. Exports from Java, on the other hand, have materially increased as may be seen from the tables below, and this island is now by far the largest producer in the world.

According to the official statistics, exports of tapioca products from Java since the year 1912 totalled as follows :—

Years.	*Cassava flour.*	*Flake and pearl.*	*Factory waste.*
	Unit : Tons of 1,000 Kilos.		
1912	41,600	12,200	12,600
1913	53,200	11,200	14,100
1914	48,500	9,600	6,500
1915	43,800	5,900	2,600
1916	59,600	7,400	900
1917	50.300	17,800	100
1918	19,800	8,200	10
1919	93,400	31,400	—
1920	64,100	11,200	247
1921	62,400	16,800	632
1922	63,300	17,800	930
1923 (6 months) ..	28,900	4,400	110

Exports of cassava flour, which in 1906 only amounted about 21,600 tons, have trebled since and amounted to 63,300 tons in 1922.

Of the various ports of shipments in Java, Batavia and Sourabaya are by far the most important; Samarang, Cheribon and Tegal coming next.

A feature of the trade is that in spite of the abnormal conditions, continually increasing freight-rates and lack of shipping facilities during the war-years, business has done very well, chiefly as a result of increased exports of cassava flour to the United States. Owing to limitations of imports in the U.S.A. during 1918, only 7,578 tons were shipped to that country, against 31,473 tons during 1917, but after lifting of the embargo on tapioca products in January 1919, shipments have materially increased. As may be seen from the following tables, showing quantities and destinations of exports of tapioca flour since 1912, Great Britain and the U.S.A. are the largest consumers of this produce :—

EXPORTS OF CASSAVA FLOUR.

Unit : Tons metric.

Year	Great Britain	Holland	U.S.A.	Singapore	Hongkong	Total incl. other destin.
1912 ..	15,173	1,964	14,606	5,780	1,869	41,616
1913 ..	15,056	4,498	22,371	5,918	1,710	53,236
1914 ..	14,749	5,460	21,258	4,823	1,251	48,546
1915 ..	14,693	7,279	13,344	2,606	1,847	43,849
1916 ..	13,261	79	37,665	4,854	2,313	59,630
1917 ..	7,549	228	31,473	5,618	2,896	50,298
1918 ..	—	—	7,578	5,630	2,780	19,792
1919 ..	16,146	20,401	44,020	6,766	1,602	93,374
1920 ..	18,824	6,600	30,354	4,827	2,419	64,140
1921 ..	17,064	8,685	18,026	6,681	2,379	62,447
1922 ..	13,343	3,805	31,018	4,755	2,608	63,374
1923 .. (6 months)	4,489	1,135	16,505	3,138	1,350	28,862

Japanese Machinery Trade

The commercial counsellor at Tokio states that the total value of the imports of machinery in 1922 was Y.114,371,000, as compared with Y.119,882,000 in 1921, whilst the total for the March quarter of this year was Y.30,891,000. A large proportion of the machinery came from the United States and the United Kingdom, whose shares in 1922 amounted to Y.57,310,000 and Y.42,203,000 respectively, as compared with Y.63,612,000 and Y.43,983,000 respectively in 1921. The bulk of the machinery imported was textile machinery, which accounted for nearly one-third of the total. Out of over 30 million yen for spinning machinery, the shares of the United Kingdom and the United States were 20 million and 8 million yen respectively. Most of the balance was worsted machinery from Alsace. As regards weaving and finishing machinery, two-thirds came from the United Kingdom and one-third from Germany, and nearly all the card clothing was British.

A very large proportion of the electrical machinery—sewing machines and printing machines—came from the United States. The machine tool trade is divided between the United States, the United Kingdom and Germany in the order named.

Robert Dollar and Admiral-Oriental Lines are Combined

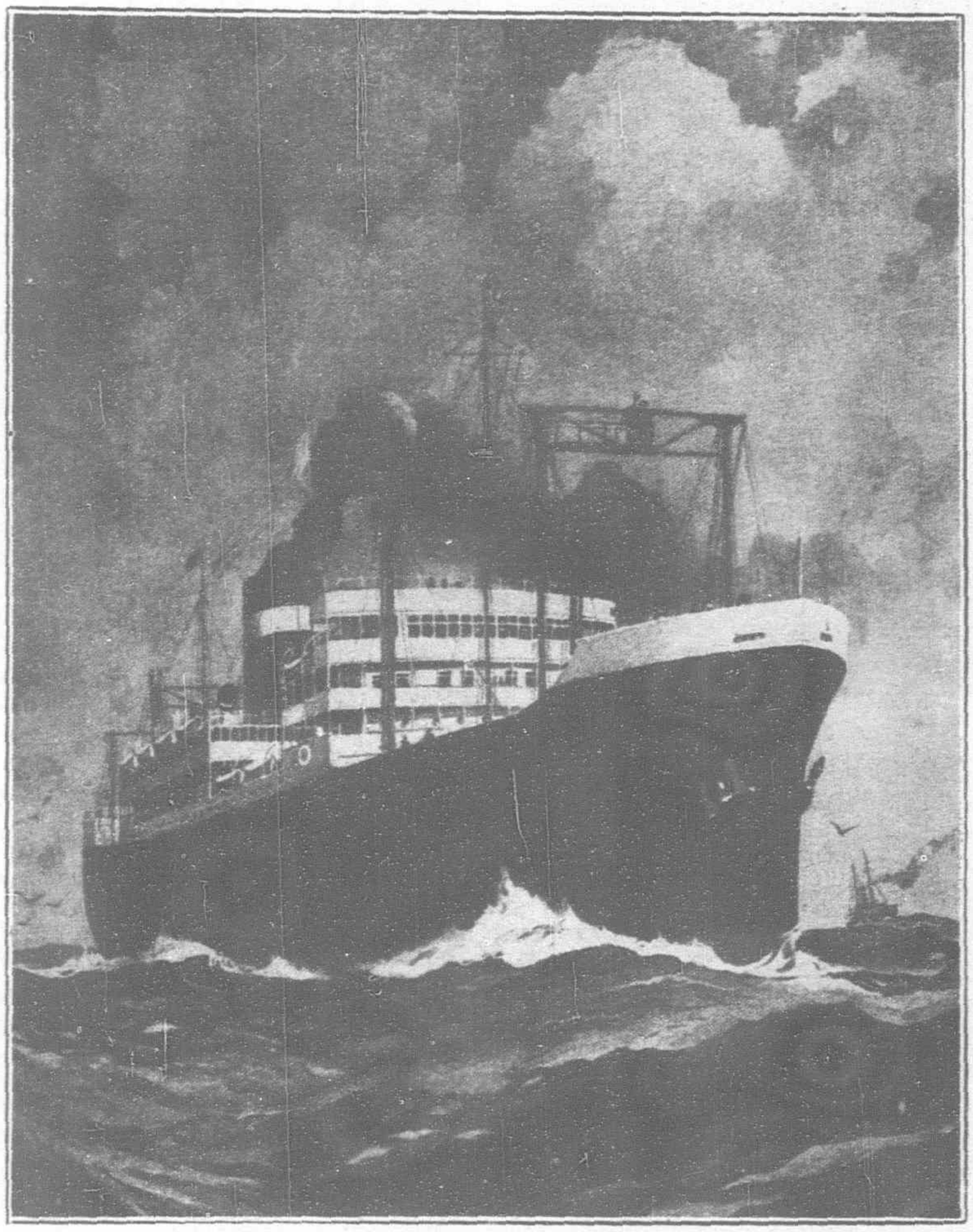
AN announcement of interest to world-wide shipping centres was made in Shanghai recently by Robert Dollar, the veteran steamship operator, when he told of the merging of the Robert Dollar and the Admiral-Oriental lines. This merger became effective in Shanghai on December 4, 1923.

The combined fleet has forty-six passenger and freight vessels, making it the largest shipping concern in the Pacific. Under the new arrangement, the Admiral-Dollar interests will have a passenger ship in Shanghai every five days and a freighter every four days, with a corresponding service in all of the other great ports of the world.

Among the ships of the fleet, particular interest attaches to the seven new "522" type vessels, the *President Garfield*, *President Hayes*, *President Harrison*, *President Monroe*, *President Adams*, *President Van Buren* and *President Polk*. Formerly these boats were in the Atlantic service where they proved to be very popular.

The "President" boats have been commended, first, for their exceptional strength and safety, and, secondly, for the expert attention given to the arrangement of the cabins and the public room accommodations. Passenger accommodations are placed amidships and all above the steamer's main deck, resulting in better light and air and the minimum of motion.

Formerly, the Dollar lines specialized in freight while the Admiral-Oriental line featured the passenger service and also handled a large freight business. By combining the offices of the two lines throughout the Far East, business interests and travelers will receive more efficient service and with a considerable decrease in operating expense. The extra expense of maintaining two offices in each port has been eliminated. At each port the staffs of the two companies were combined at one headquarters.



The new "522" type President boats that are being introduced to the Orient by the Admiral-Dollar Lines

The Dollar lines will continue to have their general offices in Shanghai from which the 46 ships of the combined service will be operated. In addition, the Shanghai general offices will maintain affiliations with other Dollar interests on the Pacific coast which will, in reality, give them a fleet of over one hundred vessels with which to transport passengers and freight to almost any point in the world.

According to tentative plans, the personnel of the combined staffs will be unchanged. The passenger and freight offices, however, will be operated separately in Shanghai. All passenger business will be managed from the old Admiral line offices on Nanking Road, and all freight business from the old offices in the Dollar building on Canton Road.

Mr. Earl F. Townsend, Oriental manager for the Admiral line, will retain his present position and in addition take charge of traffic for the Dollar line with offices in the Dollar building. Mr. George J. McCarthy, assistant general passenger agent for the Admiral line, will take charge of the passenger business of the combined lines, and freight traffic will be handled by Mr. C. A. Perkes and Mr. Don Tinling.

In regard to the organization in Japan, it was announced that in Yokohama the Admiral line will act as agents for the Dollar line with Mr. F. C. Thompson in charge of the temporary office on Satsuma-cho, constructed since the old offices were destroyed in the earthquake and fire. In Kobe the former offices will be combined under the management of Mr. E. W. Latie as agent. A separate lumber office will be maintained by the Robert Dollar Company.

As to Hongkong, the combined office will be in charge of Mr. E. L. Matteson, formerly agent for the Admiral line there. Mr. Ray Gunn will have charge of the separate lumber office. Mr. H. M. Cavender will manage the combined offices in Manila, and Mr. T. J. Cokely, the former Dollar agent in Singapore, has charge of the combined offices there.

In addition to the seven President liners, recently purchased by the Dollar company, the combine will operate five passenger vessels and twelve freighters to Seattle, formerly operated by the Admiral line; five freighters to Los Angeles, San Francisco and Puget Sound, formerly operated by the Dollar line; seven round-the-world passenger and freight vessels and five round-the-world freighters, formerly of the Dollar line; and give freighters to New York via Panama, and seven freighters to Continental Europe and the United Kingdom, formerly operated by the Admiral line for the Barber Steamship Company.

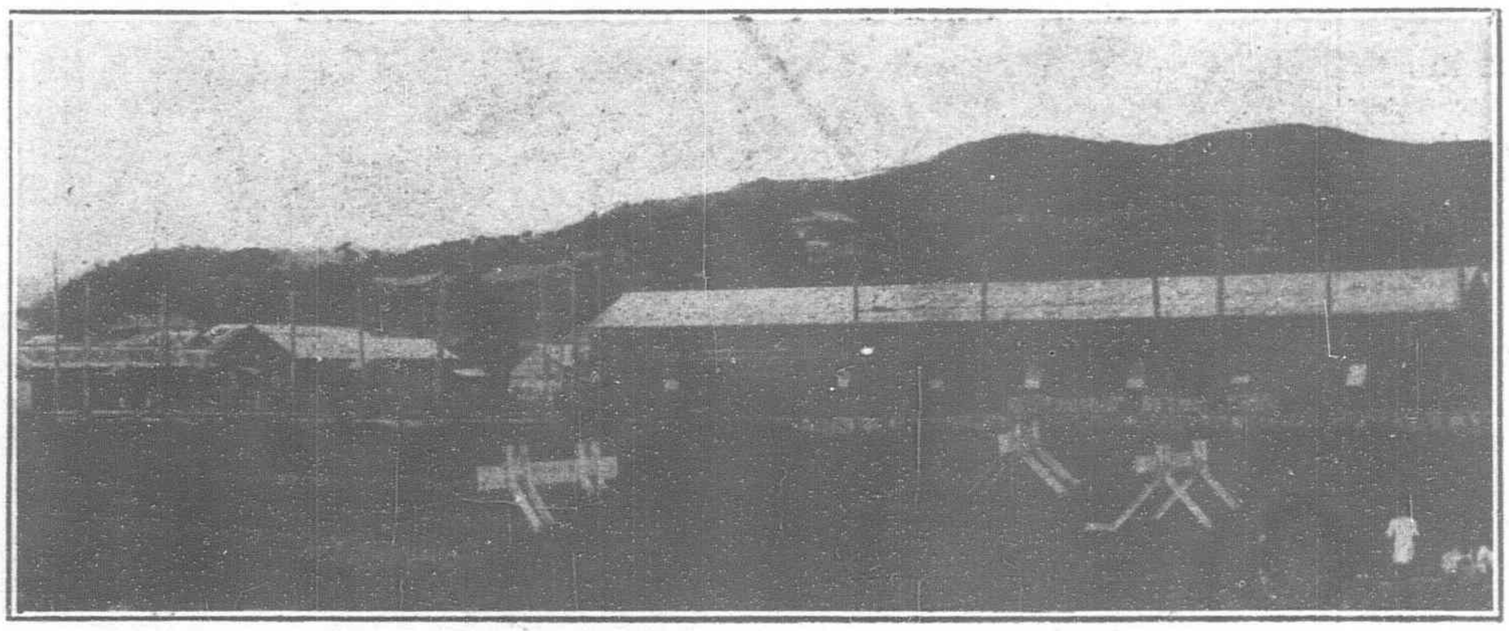
Metro-Vick Turbines for Japan

AN interesting Japanese contract has been secured for Manchester. A large destroyer, which is being built to the order of the Japanese government by the Urga Dock Company, is to be fitted with Metropolitan-Vickers impulse turbines, and the order, which has been placed with Messrs. Vickers, Barrow, will be executed at the Trafford Park works. Japan herself manufactures other forms of turbines, but not this particular type, in which the Japanese naval experts have for some time past been displaying considerable interest, and this explains why the contract has gone to England. The casings and gears are being made at Barrow.

Rapid Expansion of Electric Railways in Japan

THERE has always been a demand for rapid and economical transportation in Japan, especially along interurban lines, and this requirement was at first met by the development of light railway steam lines which now number over 200, and which form a net work covering practically the whole of the Islands of Kyushu and Honshu, comprising the major portion of Japan proper.

The gauge of these roads varies from 2-ft. 6-in. to 4-ft. 8½-in., the larger number being of the standard narrow gauge, *i.e.*, 3-ft. 6-in. The 2-ft. 6-in. gauge has of late years practically disappeared. Along with the development of the steam railways some electric roads were developed, but it is not until the last five years,—known as the post-war period, that electric railways have taken the front rank in transportation. In this period not only were a number of new electric interurban railways built or contracted for, but also a considerable number of the more important steam railways were electrified.



A suburban electric line out of Nagasaki

There are at present seventeen electric railways of importance in Japan, and out of this number eight are electrified steam road. All but one of these were electrified in the last five years, and of the remaining nine roads, three are new electric railways, built during the past three years.

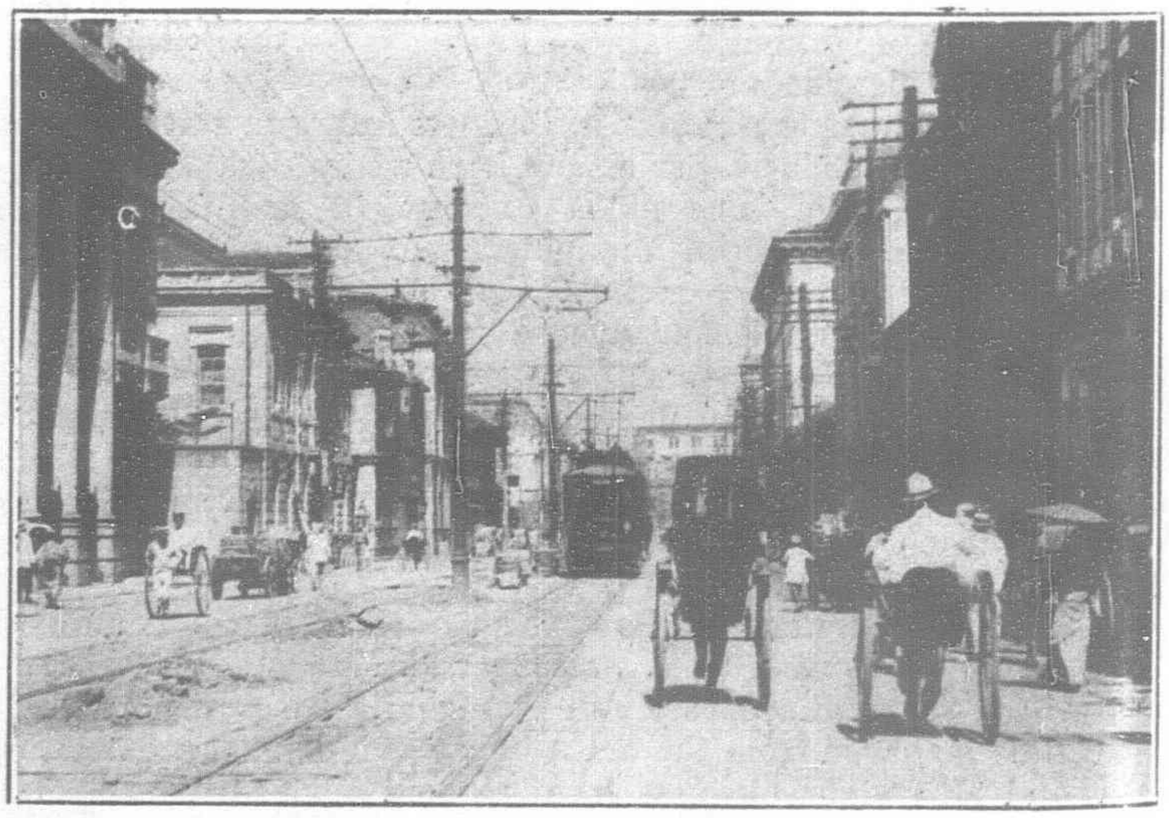
The equipment which has been installed is the result of mature investigation by Japanese engineers and naturally represents the latest and best in electric interurban equipment. In practically all cases multiple train operation has been provided for making use of the latest type of 1,500 volt electro-pneumatic control.

Motors of sizes from 60 h.p. to 100 h.p. have been used with preference being given to the larger motor. Air brakes are, of course, included, and these are generally of the straight air emergency feature type, which is quite familiar in American practice. While the recent catastrope in the Tokyo district of Japan may hold up development for a short time, there is no doubt that the cheapness and reliability of electric transportation will allow a rapid expansion of electric lines. Gasoline will always be expensive in Japan and the high import duties and excessive taxation (on automotive vehicles) will practically eliminate the gas driven car as a competitor. The present day tax in Tokyo on a Ford car is approximately $300 U.S. gold per year.

As the electrifications mentioned above represent the practice which will no doubt be followed in Japan in the future a short description of some of the more important roads is given herewith.

THE AICHI ELECTRIC RAILWAYS.—This line replaced their old equipment, consisting of British motors and single truck cars, in 1919, with the latest type of 27 M.C.B. Brill trucks with Westinghouse 646-J., 65 h.p., 600 volt, quadruple equipments. H.L. electro-pneumatic control was purchased together with Westinghouse air brakes. The operation of this equipment was so satisfactory and profitable that additional orders were placed, bringing up the total equipment to 14 cars, operating between Nagoya and Shin-Maiko —a distance of 19 miles. This number of cars enabled the company to put in operation a schedule speed of 20 miles per hour, to be maintained with 20 minutes headway.

In 1921, the Aichi Railways absorbed a projected line, called The Tokaido Railways, which contemplated high speed operation between Nagoya and Toyohashi, paralleling the main steam line of the imperial government railways. This line being about 40 miles long, naturally favored 1,500 volt operation, and had already purchased their sub-station equipment consisting of eight 250 k.w. Westinghouse rotary converters, each 750 volt, and insulated for operation two in series on 1,500 volt. These rotaries with their necessary step-down transformers and the high voltage switch equipment, were to be installed in two sub-stations, located about



THE SPLENDID TRAMWAYS OF JAPAN

Crossing the Haniwa Bridge, Osaka

On the Sakai-machi, Kobe

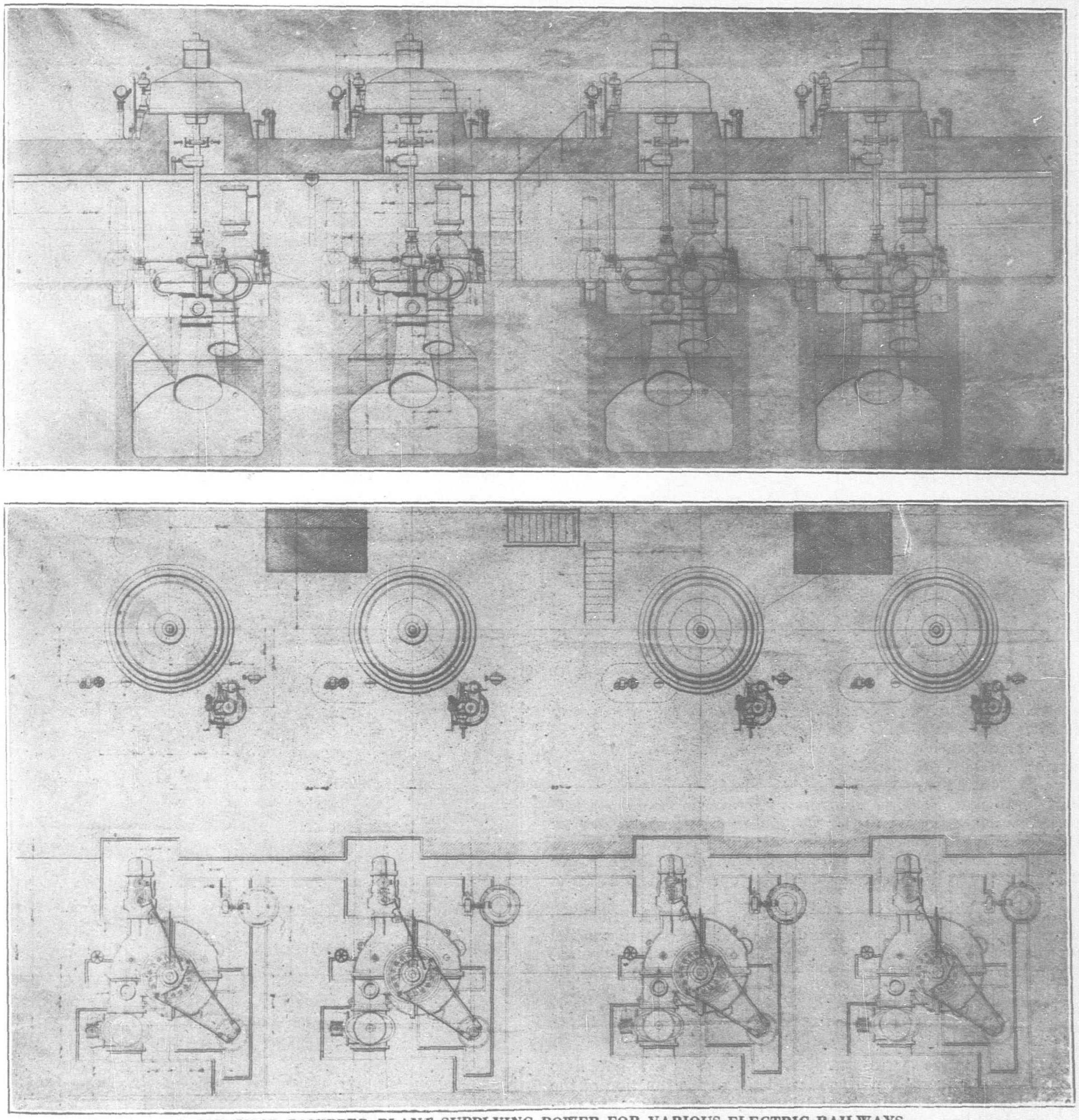
20 miles apart. The line construction is of standard double track catenary design.

On the amalgamation of the Tokaido Railways with the Aichi Railways the general manager, Mr. Eijiu Tashiro, decided on a 35 tons high-speed interurban car, to give a schedule speed of 28 miles per hour, with stops every mile.

After a careful study he purchased 14 quadruple equipments of Westinghouse 556-J.-6, 100 h.p., narrow gauge, interurban motors complete with H.L. 1,500 volt electro-pneumatic control, and Westinghouse automatic air brake with governor synchronizing system. The current collectors are of pantagraph construction, especially built for high speed interurban service, type S.-514-A. They are held on the trolley by heavy springs and are lowered by the application of air. A small hand pump is provided to lower the pantagraph in case of failure of the air supply.

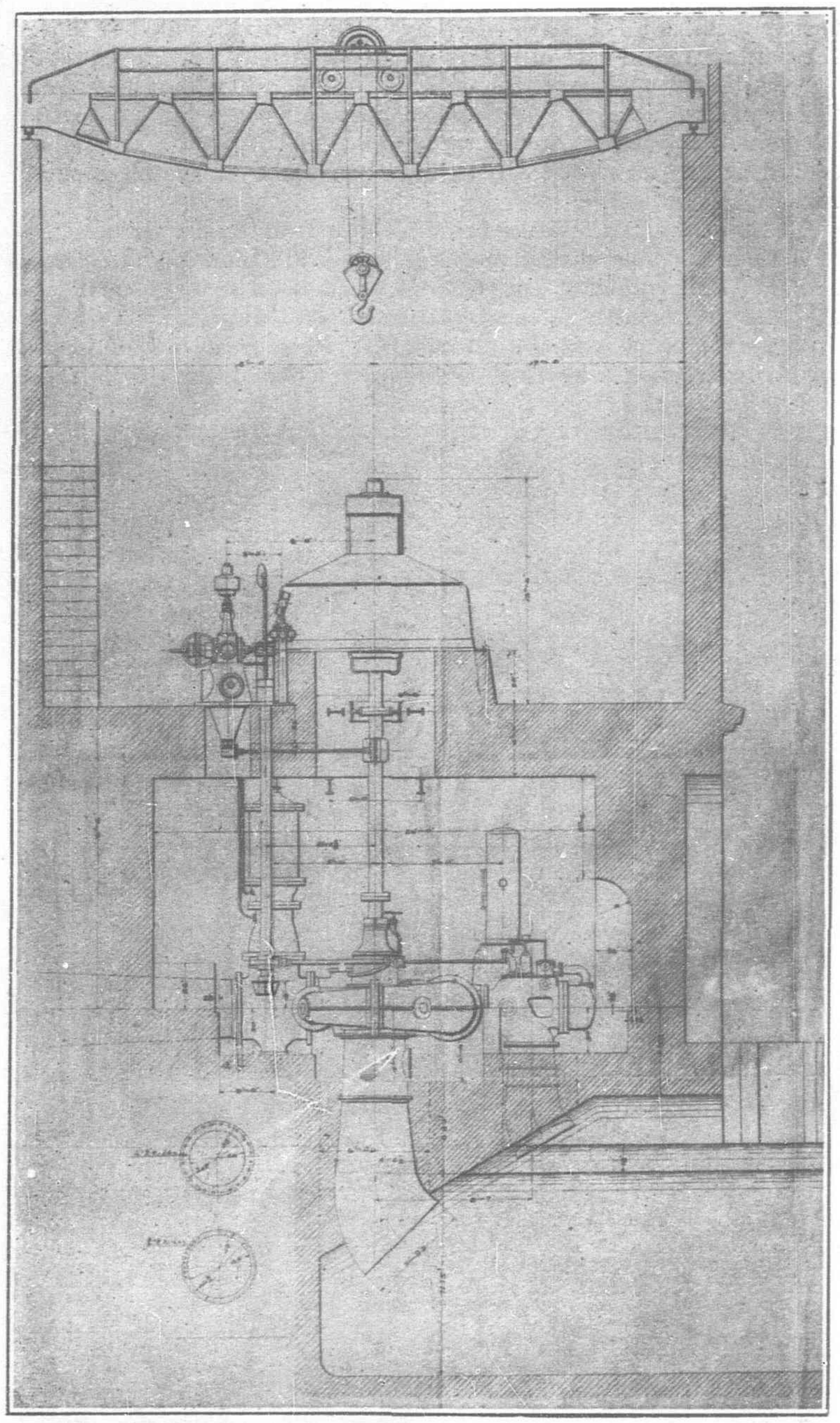
As this company still maintains its 600 volt shore lines, provision was made on five of the 1,500 volt cars to operate at eighty per cent. (80 per cent.) of normal speed on 600 volt. This is accomplished by an electrically operated change over switch, located underneath the car.

CHICHIBU RAILWAYS.—The Chichibu Railways, operating between Kumagaya and Kagemori, a distance of 31 miles, and situated about 60 miles north of Tokyo, is of peculiar importance, as it was the first independent steam road in Japan to electrify its lines. This pioneer work was begun in 1920, when orders were placed for five 41 tons Baldwin-Westinghouse locomotives, with three



A JAPANESE EQUIPPED PLANT SUPPLYING POWER FOR VARIOUS ELECTRIC RAILWAYS

Plans of the Tone Hutsuden Power Station equipped with four 5,400 H.P. vertical water turbines and generators made by the Hidachi Engineering Works, one of the foremost manufacturers of electrical machinery in Japan, controlled by the Kuhara Company



Side elevation of the Tone Hatsuden Power Plant

quadruple equipment, Westinghouse 546-J.-6 railway motors with 1,200 volts h.l. electro-pneumatic control.

These locomotives were especially designed for narrow gauge service, equipped with quadruple type 586-J., 125 h.p. field control, forced ventilated motors giving a high continuous capacity. They have ideal characteristics, giving heavy torque during the starting period and operating on short field with resulting high speed after the locomotive has accelerated to its balancing speed.

Two sub-stations were purchased, each consisting of three 250 k.w., 600 volt rotaries, insulated for operating two in series on 1,200 volt.

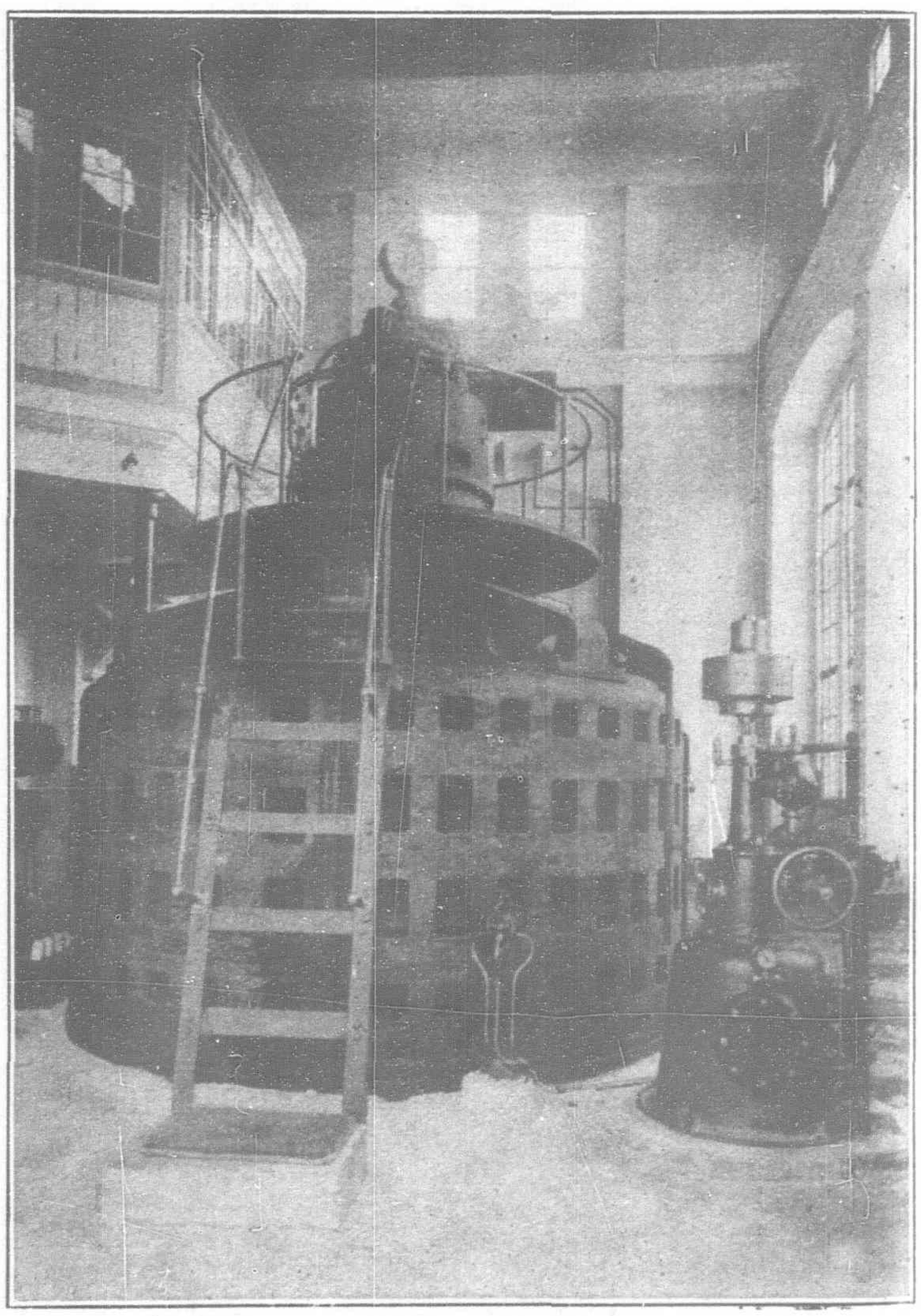
The 1,200 volt switching equipment was the first high voltage direct current switch gear seen in Japan, and it serves as a model for subsequent practice in high voltage electric railway sub-stations. It provides for the maximum of protection to the operator by isolating the 1,200 volt switches and operating them by handles placed upon the dead front panel. The switching arrangement is unique in that the three control rotaries can be interchanged quickly at will, permitting easy inspection of the machines.

The locomotive service is severe, as their duty is to haul lime stone from the quarries at Kagemori down to the junction of the imperial government railways at Kumagaya, and the greater proportion of the line is of 2 per cent. grade.

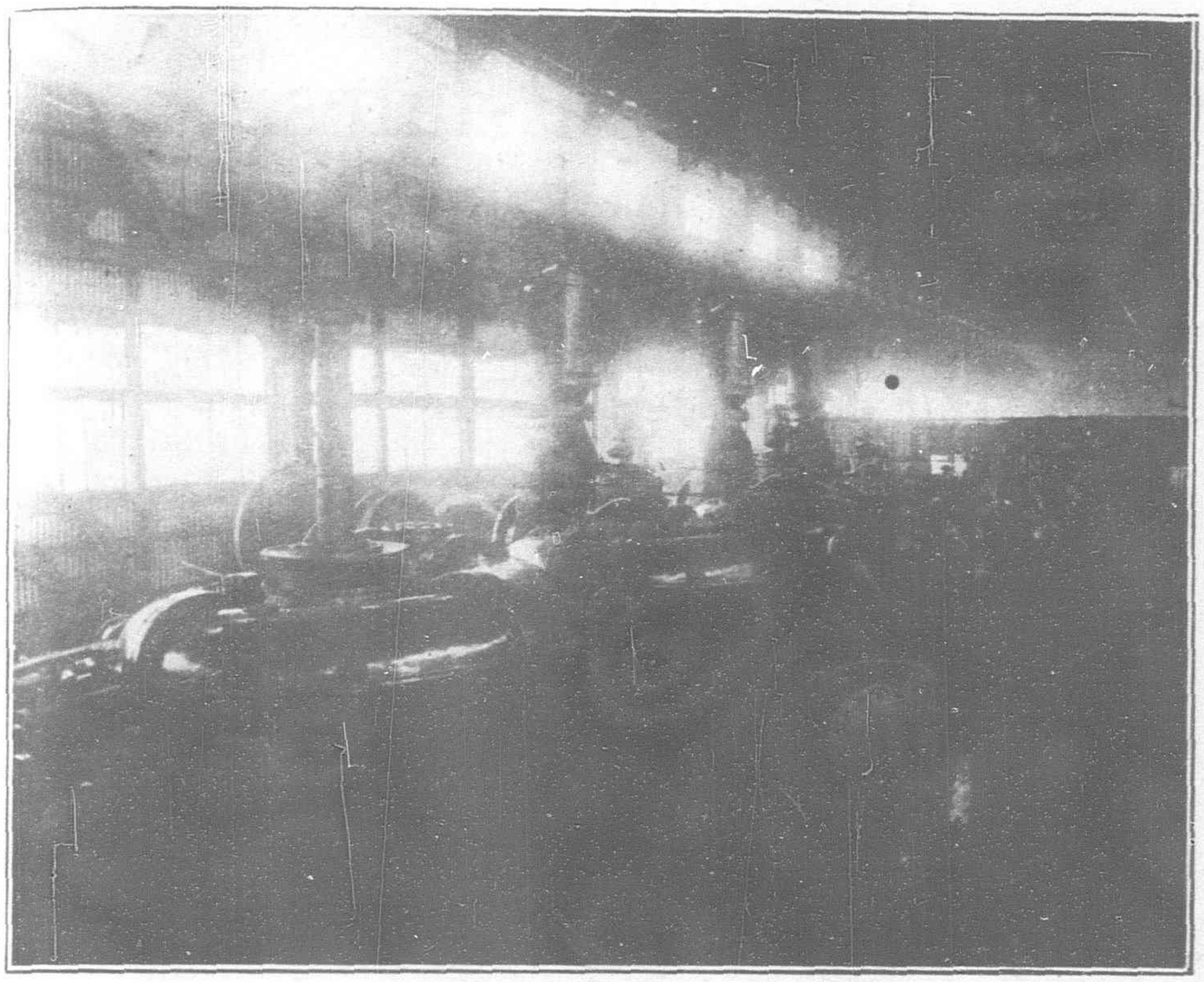
This road aroused such interest throughout Japan that in 1922, special trains were arranged to carry members of the Japanese imperial railways association to witness the operation of this line. The line was inspected from one end to the other and the smooth acceleration and deceleration of the 41 tons locomotives aroused much interest. In view of the highly satisfactory operation of their electrified road the directors of the Chichibu Railways purchased additional equipment in 1922 for the electrification of an additional 10 miles of line, consisting of four additional motor cars and a duplicate sub-station.

Osaka Railways.—The first 1,500 volt line to be placed in operation in Japan was that of the Osaka Railways, over a stretch of 20 miles from Tennoji, Osaka, to Nagano. This road had long been laboring under difficulties as their steam equipment was overloaded and the traffic was increasing every year. After careful study the company decided to accept the recommendation of the Westinghouse engineers and install a 1,500 volt electric railway equipment. Accordingly, thirteen car sets of 100 h.p., 556-J. motors of the same general type as that described above, were purchased. Adequate direct current power is supplied by four 750 k.w. Westinghouse rotaries connected two in series for 1,500 volt service. The switching equipment embodies all of the latest feature for high voltage switch gear, and makes the safety of a 1,500 volt station equal that of a 600 volt equipment.

Yoshino Railways.—An interesting steam road electrification was made not far from Osaka in 1922 by the Yoshino Railways. This road operates between Yoshino junction and the city of Yoshino, where the famous mountain of cherry blossoms is located. When the cherry trees bloom, there is naturally great congestion on this road, and it was decided that the best way to take care of the pilgrims was to electrify. Accordingly eight quadruple equipments of 540-J.-6, 60 h.p., 750 volt motors, were purchased with 1,500 volt h.l. control, arranged for train operation. The high



Japan is forging ahead in making her own electrical machinery: A 4,444 K.V.A. alternator installed at the Takezawa plant of the Kinugawa Water Power Company: made and erected by the Hidachi Engineering Works



Vertical water turbines for the Tone Hatsuden Company being erected at the Hidachi Engineering Works

schedule speed of the new equipments enable the eight cars to do the work formerly expected from four steam trains.

It is expected that further expansion of the railways in this district will be made and they will no doubt be of 1,500 volt design as that voltage has now been officially adopted as standard by imperial government railways of Japan.

The island of Kyushu, with its numerous collieries and steel mills needs electric transportation fully as much as the main island.

KYUSHU RAILWAYS.—The most interesting electric road in Kyushu is the Kyushu Railways, running between the twin cities of Hakata-Fukuoka and Kurume. This line follows the latest practice, being equipped with 16 quadruple equipment of 85 h.p. type 545 broad gauge interurban motors, with 1,500 volt electro-pneumatic control equipment, which cares for the passenger service. The freight service will at present, be taken care of by four package cars, each being equipped with four 60 h.p., type 306 railway motors, also supplied with unit switch control, power is supplied to this high speed road bytwo sub-stations, each containing three 500 k.w. 750 volt rotaries, arranged to be connected in pairs to give 1,500 volts. The third rotary in each station is a spare, which can quickly be thrown into service if desired.

This road is of special interest as it is the first line in Kyushu to order 1,500 volt, and it is expected that it will be extended to connect with other roads, so that eventually one can go from one end of Kyushu to the other by high speed interurban cars. The president of the Kyushu Railways is Mr. Momosuke Fukuzawa, who also controls the Aichi Railways, previously mentioned in this article. He is the electric power king of Japan, being the president of the Daido and Toho Electric Power Companies.

HAKATA BAY RAILWAYS.—The latest development in Kyushu is that of the Hakata Bay Railway near Fukuoka. It will operate over the historic battle ground where the invasion of Kublai Khan, the famous China emperor, was repulsed in the thirteenth century.

An initial installation of 6 sets of 1,500 volt equipment has been ordered comprising 24-type 540-J.-6 interurban motors and h.l. control duplicate of that supplied to the Yoshino Railways. The car body and trucks follows American practice and will be made by the Kawasaki Dockyard of Kobe. Suitable sub-stations consisting of 1,500 volt rotary converters with transformers and switchgear will be supplied and power will be obtained from the 60 cycle Nojima power station of Toho Electric Co., which recently ordered a 25,000 k.v.a. Westinghouse turbine generator.

As the cities of Hakata and Fukuoka have a combined population of about 400,000 people the possibilities for additional interurban railways in this vicinity are very great.

MUSASHINO RAILWAYS.—One of the most interesting steam electrifications near Tokyo has already been described in a previous issue of THE FAR EASTERN REVIEW—namely that of Musashino Railways.

This road runs from Ikebukuro to Hanno, a distance of 27 miles, and three trial equipments were ordered in 1921, consisting of quadruple equipments of Westinghouse type 546-J.-6, 600-1,200 volt, 60 h.p. motors, with h.l. control. The operation has been so successful that additional orders were placed in 1923 for four more equipments and three 31 tons Baldwin-Westinghouse locomotives. These locomotives are built for high-speed freight service, each being equipped with four 100 h.p. field control railway motors. As this is a narrow gauge railway, it will be able to haul standard freight cars of the imperial government railways to all parts of its territory. The deciding vote in favor of completely electrifying this road was the neglible maintenance of the electrical equipment with consequent reliability, coupled with the reasonable power rates which are obtained from the Tokyo Electric Light Company. A marked improvement in scheduled speed was also obtained with the electric equipment which corresponding increased the revenue of the road.

JOSHIN RAILWAYS.—Another company which was convinced of the merits of steam road electrification is that of the Joshin Railways. In 1923 they ordered three locomotives, each of 36 tons, and five car sets of quadruple equipment, 68 h.p. motors, with 1,500 volt control. Four 300 k.w., 750-1,500 volt rotary converters will supply the current. The equipment is in contrast to all other steam road electrifications, in that the equipment, even to the air brakes, is of German manufacture.

TOBU RAILWAY.—The latest and one of the most important developments in steam electrification is that of the Tobu Railways, running from Tokyo ninety miles north to a junction point with the imperial government railways.

This road has recently decided to electrify 6.6 miles of line near Tokio, to try out electric operation, and has ordered eight car sets of equipment similar to that purchased by Aichi and Osaka electric railways. Power is supplied from a sub-station consisting of four 250 k.w. rotaries of the same design as those supplied by Aichi Railways. It is expected that the Tobu Railways will gradually extend their electrified zone until they reach the juncture with the imperial government railways and the Chichibu Railways.

In spite of the recent disaster in the Tokyo district, plans for electric railways are going foward, there being at present three active interurban propositions for 1,500 volt lines, and it is easy to foresee the time when Japan will be bound together not only by a superpower system but by railway system which will link government and private roads together at a common voltage, and with uniform equipment.

The board of the South Eastern & Chatham Construction & Power Company, Limited, have intimated to The English Electric Company, Limited, Queen's House, Kingsway, and the Metropolitan-Vickers Electrical Company, Limited, Trafferd Park, Manchester, that their two tenders for motors and control gear respectively have been accepted. Those equipments are required for the electrification of the first section of the South Eastern & Chatham division of the Southern Railway, and will cover the conversion to electrical operation of the suburban services within a 15-mile radius of Charing Cross. The equipments consist of no less than 508 traction motors each of 300 h.p. with the appropriate controlling apparatus. The two contracts are possibly the largest for multiple unit equipments for main line railway electrification which have ever been placed. The work, which will give employment to many thousands of people spread over a period of nearly two years, forms part of an expenditure of £5,500,000 which was the subject of a guarantee under the trade facilities act.

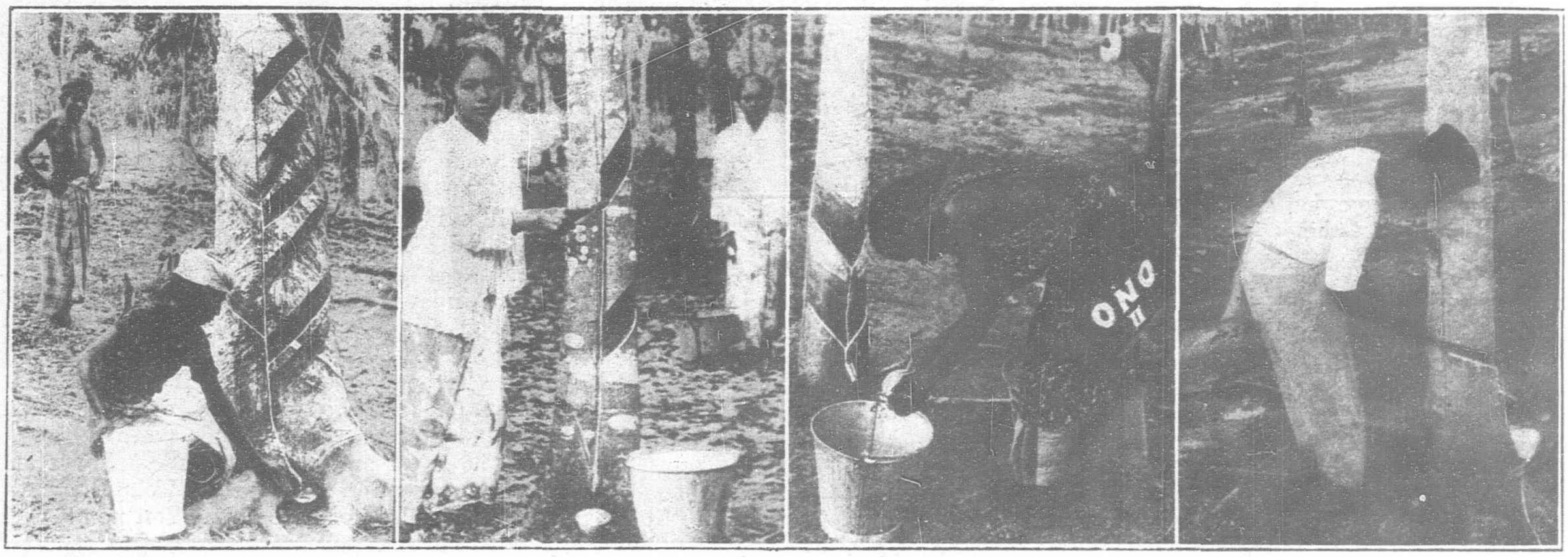
Rubber Factories on Estates

Paper Read Before the Engineering Association of Malaya

By W. J. Nicoll, Assoc. M. Inst., Mar. E.

Buildings and Foundations

FACTORY sites are generally selected to suit the convenience of the estate with regard to being in a central position, near a road, river or water supply, with the result that the foundations are not always of the best nature. In fact the majority of factories in the F. M. S. are built on unsuitable soil, but as this, in many cases, cannot be avoided, the foundations have, therefore, to be designed to suit the conditions. If " bukits " (small hills) are available they are often selected as suitable factory sites. However, factories should never be built on the face of a steep hill as this interfers with the free circulation of air in the drying sheds, which may be detrimental to the rubber therein, as the air to a certain extent ie closed off from the hill side of the buildings. The top storey of a factory built on such a site became filled with the smoke of burning refuse of the other side of the bukit—the wind blowing on behind the hill—and as there was no smoke in the lower storeys of the building, it is obvious that the free circulation of air was interfered with by the wind blowing in that direction, the current passing over the bukit and in at the jack roof of the building and causing an eddy current over it. The foregoing remark applies to a building, the walls of which were open round the bottom for about one foot from the ground as in modern factory construction. If a low hill or hard level ground is available this forms an excellent site when well cleared of trees for about a 50-yard radius round the buildings. This allows of a free circulation of air in all directions. The first consideration should be given to the nature of the soil although the water supply may require to be pumped from soms distant source.



Tapping Rubber Trees in Singapore

On soft soil it is necessary to pile the column foundations, while on firm ground such procedure is avoided by building an ordinary masonry base. The foundations for the machinery, on soft ground, must be piled with hardwood piles from 10 to 20 feet long, but this is also unnecessary on firm ground. On the latter a deep foundation is preferable, while on soft soil a floating grillage and wide foundations are adopted to reduce the pressure per sq. ft. on the soil. Some soils may only carry safely 1 ton per sq. ft. while others will carry six tons or more.

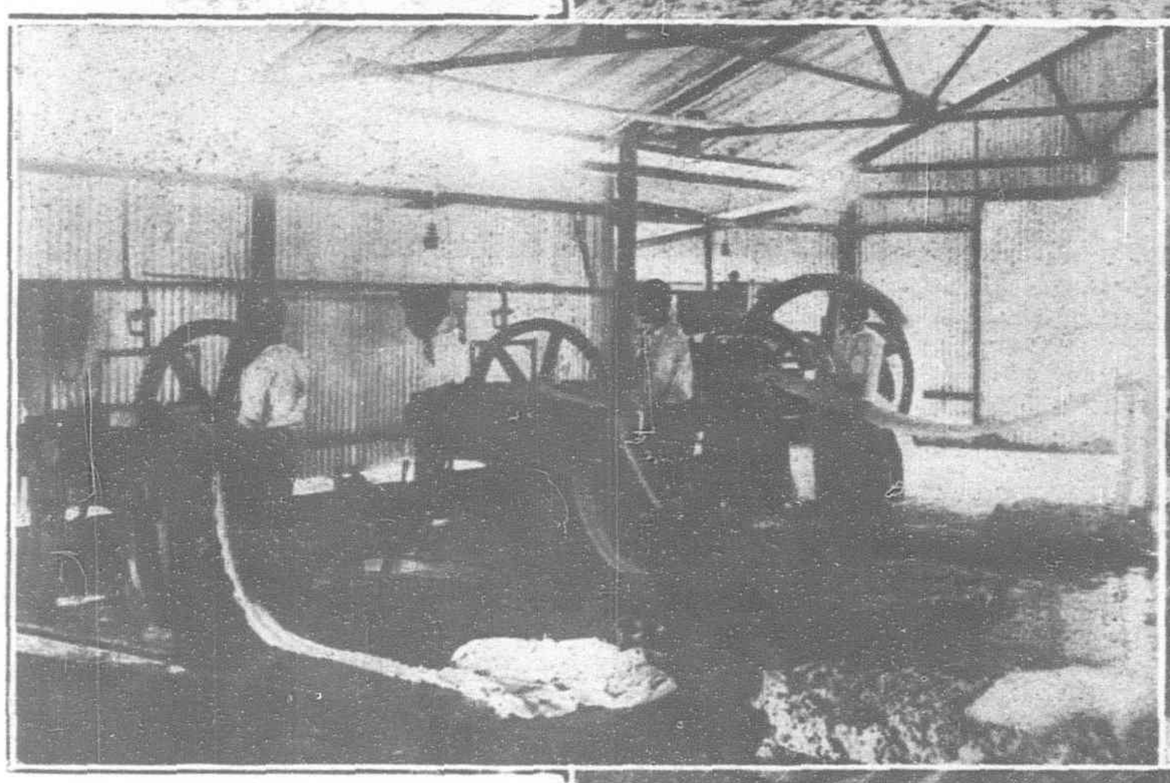
Where possible, in rubber factory construction on soft ground, all machines and line-shaft pedestals should be built on reinforced foundations, and this reinforcement—I beams preferably—to be continuous through all machine and pedestal foundations. With such reinforcement a shallow bed of concrete can be laid say about 18-in. thick under heavy machines, while 9 to 12-in. thick under light machines is ample. The area of the foundations should be varied to give a uniform soil pressure the whole length of the plant, thus avoiding any undue stresses in them. A common error on soft soil is to provide each machine with a deep bed of concrete coupled together with a thin slab, with the result that the soil is squeezed up against this slab by the weight of the machines, which ultimately breaks the concrete between the machines and upsets the entire alignment of them and the line shaft. This also applies to engine foundations which should be shallow, of a large area, reinforced and coupled to the line shaft foundations thus giving extra resistance to vibration and avoiding any turning of the engine bed due to belt pull. Floors are generally laid about 4 to 6-in. thick, 1–2-5 concrete, and should be cambered to allow water to run off. Drains of a large size are necessary to carry off factory and rain water, and if the roofs are not provided with gutters there should be a concrete apron laid 4 or 5-ft. out from the edge of the drain to catch roof water which would otherwise tend to wash away the soil from the foundations. Such aprons are also useful for the purpose of washing and drying factory utensils.

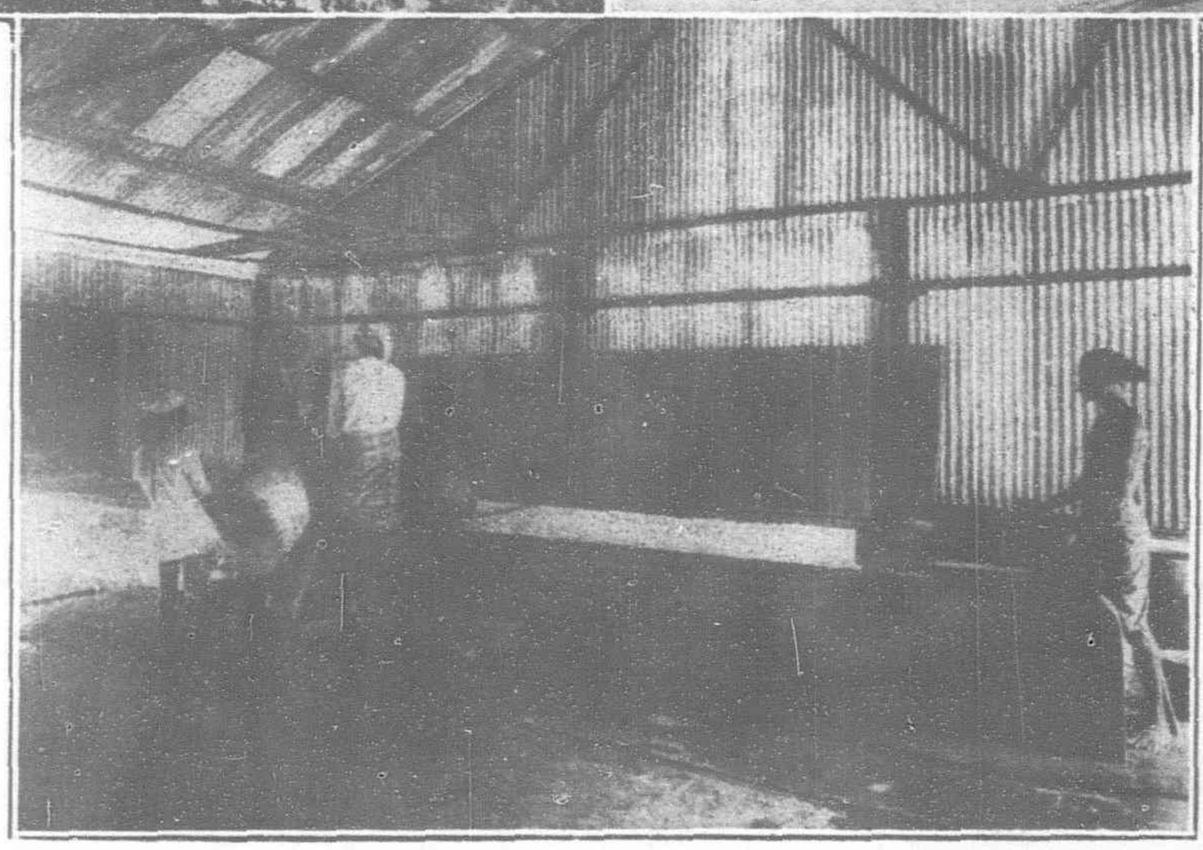
The factory buildings are generally constructed of corrugated iron on a steel framework. There are, however, buildings of wood and brickwork with tiled roofs, which give a much lower interior temperature than the iron structure. The most common fault with iron buildings is that they are too low—10 or 12-ft. to the eaves—lack of a jack roof, and are not left open round the sides, i.e., not covered with expanded metal instead of corrugated iron for about 5-ft. from the floor. At the same time the direct rays of the sun should not be allowed to enter the factory. High buildings should be constructed, say from 15 to 20-ft. to the eaves, and fitted with a jack roof to facilitate the free circulation of air. They also have the advantage of not being so hot as low buildings. Windows should open from the bottom outwards. If the interior of the factory is painted white the lighting effect is much improved. Factories should have ample space for machinery and utensils required in the manufacture of rubber. At least 2-ft. clear space should be left between each machine to facilitate the repair of machines, which should also be from 6 to 8-in. above floor level. The floor space around the machines should be tiled, as dirt and grit are less liable to get into the rubber than with a concrete floor, which in time disintegrates through the action of acids. For tables, the reinforced tile table has superseded wooden tables, as the former are much cleaner and have a longer life. When the producer gas engine is used the generater room should be paritioned off from the rest of the tactory to aviod dust entering herein. This is also advisable with the engine, but is in many

cases impracticable, the reason being that all machines should be in view of the driver.

With regard to necessary crepe drying accommodation the size of shed is governed by the quantity of crepe manufactured. A reasonable allowance is from 6 to 8-lb. per month per sq. ft. of floor space, but again this depends on location of shed, its design and extra space required for further estate development. If possible they should be built at least two or three storeys high with an opening of about 2-ft. round the bottom of the walls to allow a free inrush of air. This opening can be covered with expanded metal also. An adequate jack roof should be fitted the whole length of the building. Windows should also be provided at intervals. Although they should always be kept shut during the drying of the rubber, they are necessary to allow of the examination of the rubber. To facilitate the drying of the crepe in the upper storeys, the ground floor of a crepe shed should be left clear, but may be used as a packing room or store. The floor should be of concrete and from 1 to 2-ft. above ground level. Ample provision should be made to carry off rain water, and on very high buildings gutters should be fitted to prevent the roof water from washing away the foundation soil. Crepe drying sheds should be built at least 50-ft. away from the factory, as insurance companies now insist of 50-ft. clear space between all buildings.

Smoke house foundations need careful attention on soft soil, and should always be piled. The size of smoke house depends on the crop of the estate, but with an "ordinary" type 60 sq. ft. per 1,000-lb. per month is a reasonable allowance. With the "Double Devon" type this allowance can be halved, for with this smoke house one gets continuous smoking, and there are no passage ways required in the smoke room between the racks, as the latter are drawn out on to a verandah for loading and unloading. This type allows of the work on the rubber in a much cooler temperature than with the former, while no smoke escapes during loading operations, as the inner end of the rack forms a door when the rack is drawn out. This latter type is now the most common in use, as it is economical in fuel. Fire boxes may either be mounted on rails for withdrawal or sunk in the ground and charged inside the smoke room. With the latter, care must be taken that the bottom of the fire box does not go down to the high water level in the ground; otherwise in wet seasons the smoke house would become full of saturated air. This can be avoided, however, by having the boxes watertight, or, even better, by laying them in a mason-work cylinder with a closed bottom, and with a space of about 6 to 12-in. round the fire box to allow the heat to radiate up into the smoke room. All fire boxes should be covered with perforated covers, and in addition should have hoods hung above them to prevent dust and flames rising into the rubber. The first and subsequent floors in the ordinary type smoke house should be "spar-floored" and covered with gauze. In the double Devon type this is only necessary on the first floor, or may even be omitted, as there is no work done on the rubber inside this smoke room. Smoke houses are generally constructed of a steel framework, corrugated iron and brick-work, brick walls to the first floor and corrugated iron for the remainder. In modern practice, however, brick walls are carried up the whole height of the building, as they tend to retain more heat and therefore facilitate the drying of rubber. Floors should be of concrete so that any collection of dust can be easily removed. With the earth floor particles of dust tend to rise with the air and settle on the rubber. Roof coverings may be either of tiles, genasco, wood or corrugated iron. The latter does not have the lasting qualities of the former three owing to the action of heat which causes rapid corrosion.



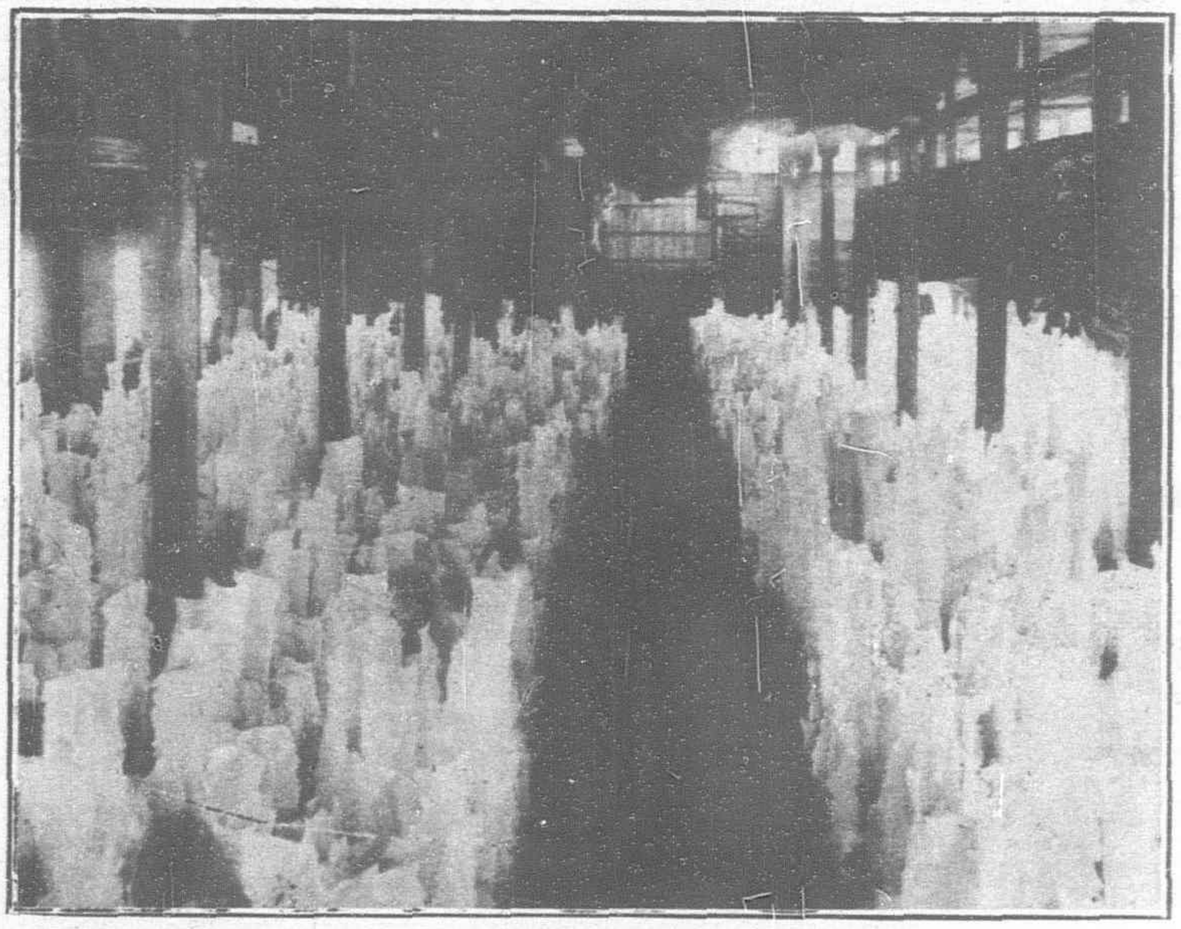


Collecting the Latex
Rubber Washing Machines
Coagulating Tanks

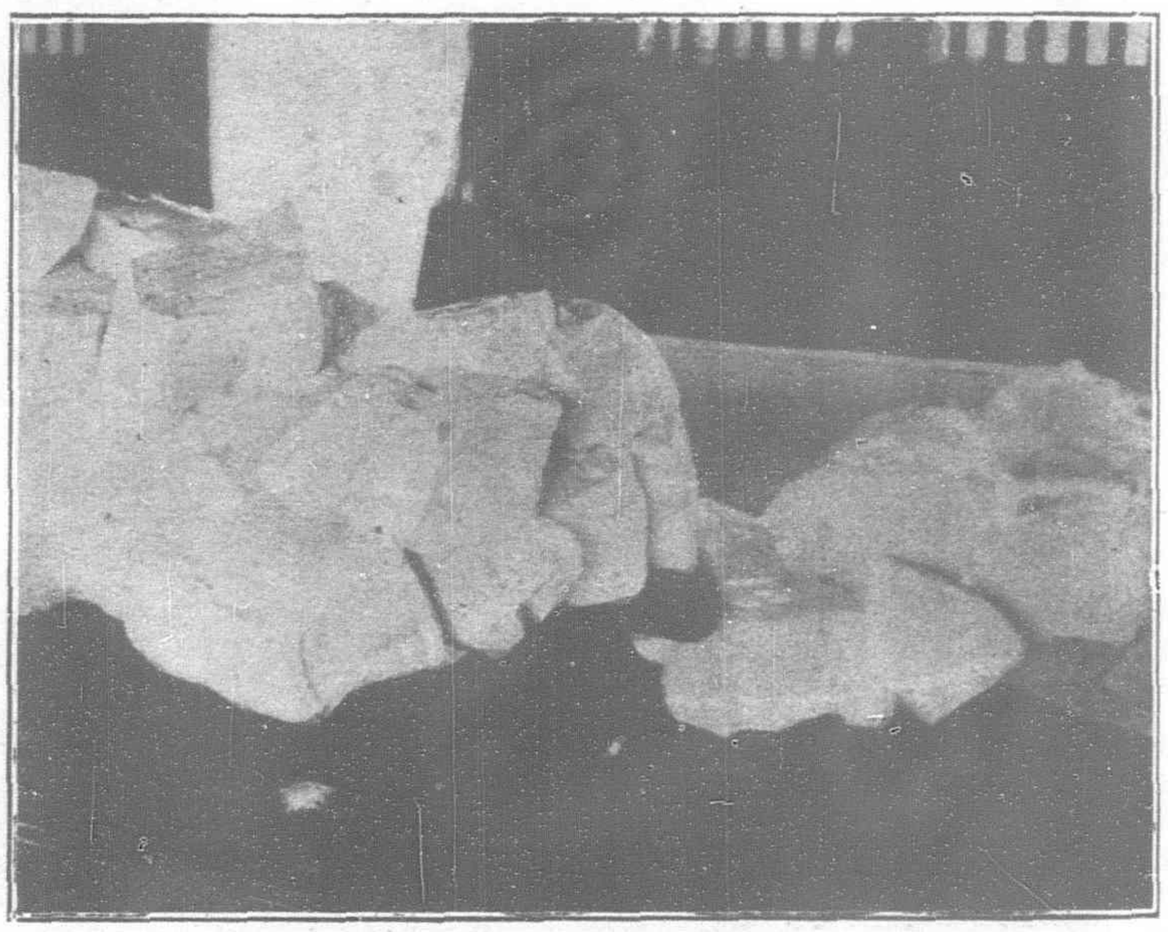
Water Supply

In the manufacture of rubber a good water supply is essential. This may either be drawn from an open well supplied by a catchment area, public supplies (i.e., town mains), rivers or bores. The

water from town mains and rain water wells is the most preferable of these sources although bore water when chemically treated for hardness suits the purpose well, provided it is not in any way polluted with vegetable or organic matter. Field surface drain and river water has generally to be filtered, and although the initial expenditure of a mechanical filter may be high, it is well warranted, as such water usually contains a high percentage of impurities which are detrimental in the manufacture of rubber. The water obtained from a river supply should be avoided, however, where possible. Storage tanks should always be provided at from 10 to 30-ft. above the factory level, or even higher if convenient to give the water additional head, and should contain about a full day's supply. In order to allow the water to settle one night before using and to be undisturbed by the pumping in of water when using, it is preferable to have two similar tanks where one can be filled while the other is running off. Unless in gravity systems these tanks are filled by means of pumps, which should be duplicated in case of a breakdown. Where the storage tanks are some distance off, the pump delivery pipes at the factory can be led into the return pipe from the tank. This system does not only save considerable expenditure in pipeline but is also useful when cleaning or painting the



Drying Crepe Rubber



Ready for Shipment

tanks, as the factory can still be run directly off the pump, while any surplus can be allowed to overflow. A fair average consumption of water for a battery of six heavy machines, one scrap-washer and four small machines is approximately 1,200 galls. per hour. In addition to this, allowance must be made for cooling water for the engine and for a gas producer—if a suction gas plant is installed. A safe allowance for the latter two is from 800 to 1,000 galls. per hour, which applies only to plants in these tropical climates.

Machinery

PRIME MOVER AND RUBBER MACHINEC.

Prime Mover { Steam Engine. / Internal Combustion Engine.

After generally reviewing steam versus the internal combustion engine and finding the latter to be the more economical, it will be considered as the usual prime mover in the preparation of rubber in the F.M.S. The producer gas engine is more commonly used than the oil engine, as charcoal can be made cheaply, and gives very cheap power. Wood-burning plants are in operation which convert all the fuel into heat, unless some tar deposits. This applies to plants with the "updraught" system. The improved Ackroyd plant, however, is designed to burn all the tar. The principal feature of this generator is the down draught in the fuel combustion chamber. A certain amount of heat is wasted in making the charcoal for the charcoal-burning plant.

The selection between the wood-burning plant and the charcoal plant entirely depends on the convenience of wood supplies and their likely duration. Where a large quantity of wood is procurable within easy reach of the factory or road, the wood plant may be favorably considered, while on well matured estates, where jungle timber is scarce and only fallen rubber trees to rely on, at some distance away or often a distant jungle, the charcoal plant is generally accepted. This plant is also much cleaner than the ordinary wood-burning plant as a tar extracting device is unnecessary. In addition to field-made charcoal, charcoal from the smoke house can go a long way to supply the plant. A fire box 4-ft. deep by 4-ft. diam. will produce from rubber wood at least 1,500-lb. of charcoal per month, while the average consumption of an engine developing 40 to 45 B.H.P. is 50 to 54-lb. per hour (1-lb. charcoal=12,000 B.T.U.). Therefore six such fire boxes will provide fuel for 160 to 180 hours' run per month. It must also be remembered that this as firewood has already been paid for and has done its work in the smoke house, while the cost of cleaning the fire boxes and charcoal is very little. Thus the cost of fuel from this source may be as low as 4 cts. per hour for the engine under consideration. The decisive factors with regard to the coal-burning plant are the cost and transport of the coal, and considering a tar extracting device is necessary with this fuel, the running cost may be greater than that of the crude oil engine.

On many large estates where charcoal consumption would be heavy and in excess of available timber, either kerosene or crude oil engines are used. At the present time the latter have superseded the former to a very great extent owing to the high fuel costs of the kerosene engines, although in small factories or as pumping engines they are still in use. That applies to engines up to about 8 horse power. Small kerosene engines are more suitable for such purposes. However, above that rating, the crude oil engine, either Diesel or semi-Diesel, is generally installed. The average consumption of fuel oil is about 0.5-lb. per H.P. per hour; therefore, with oil at a reasonable price, the user may have power at a price between 1.5 and 2 cents per H.P. per hour. However, as the running costs of the crude oil engine depend mostly on the price of the fuel, which latter varies with the supply and demand, the costs at any time become very high, whereas with the producer gas engine fuel costs remain at a very level figure, at from 7 cts. to 1.0 ct. per H.P. per hour with ordinary field-made charcoal. With the gas engine there is also the upkeep of the producer plant in addition to the engine, and when "all-in" running costs are considered they may ultimately be much in favor of the crude oil engine. However, a producer plant will run a long time burning coal or charcoal when carefully handled.

On account of the high efficiency of the modern crude oil engine, the planting community generally give it the preference without much consideration to the fluctuating prices of fuel and available local fuel products, which in many cases would give cheaper power.

The size of the engine selected depends on the number of machines it has to drive and likely to drive, and a fair margin of power must be made for further extensions according to estate developments.

As rubber in a coagulated condition is perishable, and also in case of break-downs, it is necessary to have a stand-by engine which, if possible, should be a duplicate of the other so that one set of spares will only require to be stocked.

As the installation of plant on a rubber estate has to be carried out on as economical a basis as possible—from a financial point of view—at the commencement of rubber production of the estate, a primemover of sufficient capacity only to deal with the existing requirements—immaterial of developments—is generally installed. This is rather contrary to my previous remark, but the former alludes to estates which are in a sound financial position at the commencement of rubber production, and which are able to take into consideration the ultimate development of the estate. For estates up to 1,000 acres an engine of 35 B.H.P. is sufficient, while for larger acreages an allowance of about 20 B.H.P. per additional 1,000 acres is ample.

As it is necessary to have a water-circulating system round the cylinder of the internal combustion engine, this may either be of the "run-through" or "syphon" system. With the run-through system it does not necessarily mean that the water runs to waste, as it may either run back into a reservoir or be used direct in the factory for washing rubber or tanks, etc. If an ample supply of water is available, this is the more preferable system, as the engine cylinder remains at a more even temperature than with the other, where the water circulates through a series of tanks, and at the end of a day's run may be very hot. The temperature of circulating water should not be more than 150 degs. F. Beyond this the temperature in the cylinder *would be too high* for ordinary cylinder oil which would carbonise instead of doing its allotted work, with the result that the piston would become seized in the cylinder.

Rubber Machines

In the manufacture of sheet rubber, light machines are used with rolls 6-in. diam. by 18-in. long running at a speed of about 30-ft. per min. A battery of these should consist of three machines with smooth rolls and one with grooved or marking rolls. Some small estates still use hand rolls with good results. Where afternoon rolling is in practice this number is essential, as the coagulum then is much softer than on the following morning, and it should be reduced in easy stages to avoid its breaking up. The marking machine is necessary to give the sheet a rough surface in order to facilitate drying, improve surface appearance and aid in the unpacking of the rubber. This machine also impresses the estate name on the sheet, which is useful when examining the various estates' rubber on the market, as in some cases it may be the only means of detecting the rubber, should the packing case be broken up. These machines are light to drive and for a whole battery in good order an allowance of 4 B.H.P. is ample. A good supply of water is essential in the manufacture of sheet, and should be distributed evenly over the rolls. The purpose of the water is to wash the serum off the rubber. For creping purposes heavy machines are necessary. A battery should consist of one heavy macerator, one crepe machine, two smooth roll machines and one scrap washer. Such a battery would be sufficient for a crop of 15,000 to 18,000-lb. of crepe per month including all low grades, while to drive this battery a 40 B.H.P. engine would be necessary.

When the coagulum is removed from the tanks it is passed through the macerator mill (that applies only when the coagulum is being made direct into first latex crepe) the rolls of which are generally diamond grooved 10-in. pitch, $\frac{1}{2}$-in. centres and about $\frac{1}{4}$-in. deep. These rolls are usually 12-in. diam. and may be 15 or 18-in. wide according to the type of machine, while their speed is about 60-ft. per min., and the ratio of the speed of the back roll to the front roll is as $1\frac{1}{2}$ to 1. This variation in speed is necessary to assist in the washing and mixing of the rubber. The rubber leaves this machine in blanket form, and is passed on to the creping mill, the rolls of which are not so deeply grooved, usually about $\frac{1}{8}$ by $\frac{1}{8}$-in. The crepe is thinned out in this mill prior to passing to the first smooth roll machine, which may have even speed rolls, while the second smooth roll machine has a surface speed ratio of $1\frac{1}{2}$ to 1. The latter machine is the finishing one, and the crepe should leave this mill about .02-in. thick in order to facilitate drying and thus check disease in the rubber. The output of crepe is governed by this machine, and if the rolls are 15-in. wide this will be about 60 to 80-lb. dry rubber per hour. The mills should never be allowed to run empty as the rollers grind on one another and destroy their surface, while they also give the crepe a streaky appearance thereby.

When installing machinery in a factory a type of machine should be selected which is easy to operate and with no unnecessary or complicated gear to get out of order. All operating gear should be easy of access, bearings large in diameter and a good system of grease lubrication provided for the rolls. Main shaft bearings should be ring-oiled if possible, and provision made against water entering them, otherwise the oil would soon be washed out, with bad results to the bearings. Various types of machines should not be installed in a factory as each type generally has a different back-shaft speed, and the machines fitted with their standard gears would give uneven roll surface speeds. There is another important reason why machines of various types should not be installed, that is, spares are required for each type, and their combined value may be a considerable amount. With a battery of machines, say six of one type, all the spares that are necessary to stock, are two pairs of rolls, one spur wheel, two roller pinions, two shaft pinions and sundry cluth details which are liable to excessive wear.

All machines should be fitted with friction clutches, as it is impossible to declutch a dog-clutch when the machine is loaded.

To wash low-grade rubber scrap washers are employed. These many either be of the single or double rotar type. In the double rotar washer, the two rotars are provided with helical vanes which mesh with each other when revolving, while the scrap passes between them. Behind each rotar is a concave fluted cast iron plate, which is about $\frac{1}{4}$-in. clear of the rotar. In the bottom of the casing is a grating to allow the water and the bark shavings to run off. In the single rotar machine a series of fluted discs are mounted on a shaft with spacing collars between them. Stationary webs are fitted in the casing opposite the spaces between the rotar discs. The scrap rubber when put into the machine is forced between the discs and the webs and round the face of the discs. The rotar travels at a speed of about 25 R.P.M. and the machine with a rotar 18-in. long will wash on an average 100 to 150-lb. per hour with a plentiful supply of water plying on the scrap rubber which is removed in lump form. The single rotar machine is the one most generally used on small estates, while, where a large quantity of rubber has to be dealt with, the double rotar type has the preference, in fact, is superseding the former very rapidly as the rubber is washed faster, is less liable to damage by a heated rotar, and is easier to drive.

Scrap washing machines should be partitioned off from the other machines in order to avoid the conveyance of dirt into the interior of the factory, which should be kept absolutely clean. This may entail a belt drive or extra line shafting. With the latter it would be necessary to carry a heavy shaft right out to the end, whereas if a belt drive is employed the scrap washer can be driven off the main shaft near the main drive. The most common situation, however, is on the main shaft, thus avoiding any belt transmission, but it is imperative that a reasonable space be left between the scrap washer and other mills.

If cost is a secondary consideration when selecting mills, machines with cut gears should first receive attention, although there are many good mills on the market without such gears, and give equal results if properly manipulated. Rolls of good, hard and close grained cast iron are necessary as soft rolls may destroy the rubber by the disintegration of the soft cast iron. It might be mentioned that any streaks on crepe are very detrimental to its value. Provision must also be made to prevent the rubber passing the ends of the rolls by means of close fitting side guards or wooden blocks lying between the rolls. The latter method is dangerous as the block may spring out and strike the operater in the eye, as has already happened.

Main Drives

Some engineers consider that the engine geared to the main shaft gives the best results. However, the engines are generally placed behind the machines, and for the purpose of having an "open belt drive," it is necessary to do either of the following:—(*a*) drive by belt to a countershaft geared to main shaft, (*b*) drive direct to main shaft by belt with breech end of engine in towards machines, or (*c*) reverse the rotation and position of the engine with the breech end out from the machines and with a drive as in (*b*).

Reversing the engine is not to be recommended. The method adopted in (*a*) is very satisfactory as one can move freely round the

breech end without coming into contact with the belt. The most common method, however, is that adopted in (*b*), although this may entail a heavier belt than that used in (*a*) owing to its slower speed. The clutch is generally fitted to the main shaft, although in some cases it is fitted to the engine. With the latter method a smaller cluth can be used for the same horse-power owing to the engine's speed being higher than that of the main shaft.

Where there is only one engine the ordinary type of clutch is used—i.e., the pulley runs on the main shaft and has fixed to it a shell or rim into which the clutch engages. The pull of the belt is transmitted to the shaft bearings on each side of the pulley. If this belt is heavy and long the pull may be considerable, and if the bearings are not sufficiently large there is the tendency of excessive bearing pressure resulting in heat. To avoid this, however, a quill shaft can be installed with independent bearings to take the belt pull. The main shaft in this case runs through the quill and only carries part of the clutch, the other part being fitted to the quill. This method also avoids any tendency to bend the main shaft when running.

Where two engines are installed this latter type of drive is much to be recommended, for when one engine is working the belt pull of the idle engine is transmitted to the stationary quill, and not to the shaft, as is the case with the ordinary loose pulley, incurring heavy wear and frictional losses unless the belt is removed. Of this type of cluth there are few in the F.M.S.

In compliance with the machinery enactment it is essential to have a safety declutching device which can be operated from any machine. This can be accomplished by having a cast iron weight sliding on a vertical standard and coupled to the main drive clutch hand-lever by means of a wire rope running over a pulley fixed to the standard. The weight can be hung by a trigger to which is attached the wire rope that extends over all the machines. If properly arranged a 4-in. depression on the wire should be sufficient to release the trigger which in turn releases the weight and ultimately the clutch. If the machines are loaded when the safety device is tripped the main shaft will not revolve more than one rev. which means a very small movement of the machine rolls. The wire should be placed just in front of the operator's chest, as the most common accidents are that of his hands being caught in the rolls, and by endeavoring to release his hand or hands he will fall forward on the wire and automatically stop the machine.

As already mentioned the individual machine friction clutch may prove of service in case of accidents, but it is very unlikely that an operator whose hand is caught can catch the operating lever with the other especially if the opposite hand. Hence it is essential to have a device which can be operated with the body.

General

In the manufacture of rubber, cleanliness is absolutely necessary. Machines should be periodically washed with a solution of caustic soda and water, all surplus grease removed from ends of bearings and finally washed with clean water. All shafting and brass work should be cleaned daily. To some this may seem unnecessary and a wasting of money and time, but if carried out systematically can be done on an economical basis. By keeping the machine clean the coolies develop clean methods of working with the rubber and utensils in the factory. The engine valves and combustion chamber should be cleaned once per week, or after running about 100 hours, while the water jacket scour cock should also be opened weekly for say a quarter of an hour.

If using charcoal as a fuel the scrubber should be thoroughly washed out yearly and fresh coke put in, while the old coke can be laid out and put back the following year.

In order to compare daily consumption, records should be kept showing the number of hours run, fuel and lubricating oil used, and remarks. These can be summarised as for any period. Should fuel consumption be increasing one can immediately start to trace defects in valves, leaks in pipes and generator (in gas plant), or in the generator brick work which may have fallen in.

Cleanliness also applies to the exterior of the buildings. Drains should be kept clean and occasionally disinfected with Jeye's fluid. Weeds should be eliminated so that the seeds cannot blow into the factory and settle on the rubber. Machine and engine stores should be kept in a separate shed, dried and occasionally oiled. Records of these spares should be kept—i.e., when received, when issued and balance in stock. Similarly repairs to machines should be entered in a log book, so that to trace the result of any adjustment and the fitting of any new part would not be a difficult matter.

Fuel stores, especially charcoal and firewood, should be clear of the factory buildings in order to obviate dust entering them. Charcoal stores should have a watertight roof to keep the fuel dry in order to avoid spontaneous combustion.

In conclusion, the data in this paper is not to be considered as hard and fast, but general, with suggestions which may be of use to those engaged in the construction of rubber factories and carrying on the manufacture of rubber.

Japanese High Voltage Power Transmission Systems

(*Continued from page 739*)

22,000 volts through three 1,500 kv-a, three-phase transformers, 11,000 to 22,000 volts, at the Noe No. 3 substation. Power for the Osaka-Koya Railroad is supplied at 11,000 volts by the Dotombori substation. The other important customers and connections can be seen from the diagram shown in Fig. 11.

The Ujigawa Electric Co. is contemplating the installation of a 30,000 kv-a transformer station, stepping up the voltage from 11,000 to 22,000 volts, as they intend to change over some of their longer or more heavily loaded circuits to the higher voltage.

The Nippon Power Co. with which the Ujigawa Electric Co. is affiliated, contemplates the installation of a new steam station in Osaka. This station will deliver 20,000 kv-a at 11,000 volts through the Kujo switching to the Ujigawa system and will deliver the balance of its power to a transformer station where it will be stepped up to 55,000 volts. At this voltage, 35,000 kv-a will be supplied to the Yamatagawa substation and 15,000 kv-a will be delivered to other points of the system. The main connections proposed for this plant are shown in Fig. 12, which indicates the immediate installation of two units of about 25,000 kv-a capacity each and the ultimate installation of four units.

Each generator is provided with its own exciter, but provision is made for utilizing a spare exciter in case of emergency. The neutral of any or all of the generators can be connected to a neutral bus, grounded through a resistance. Each generator is connected through a circuit breaker and two sets of disconnecting switches to either of two 11,000 volt busses. These busses are so sectioned that units No. 1 and 2 are on the left end ; and units No. 3 and 4 are on the right end. House transformers of 2,500 kv-a capacity connect each end of the 11,000 volt main bus to corresponding ends of a 3,300 volt house service bus and there will be a house turbogenerator connected to end each of this house service bus. The house service bus in turn feeds the turbine room auxiliary bus, and the boiler room auxiliary bus. The ultimate plant will have four 5,000 kv-a feeders at 11,000 volts, four transformer banks stepping up to 55,000 volts and two 50,000 kv-a, 50,000 volt outgoing feeder circuits.

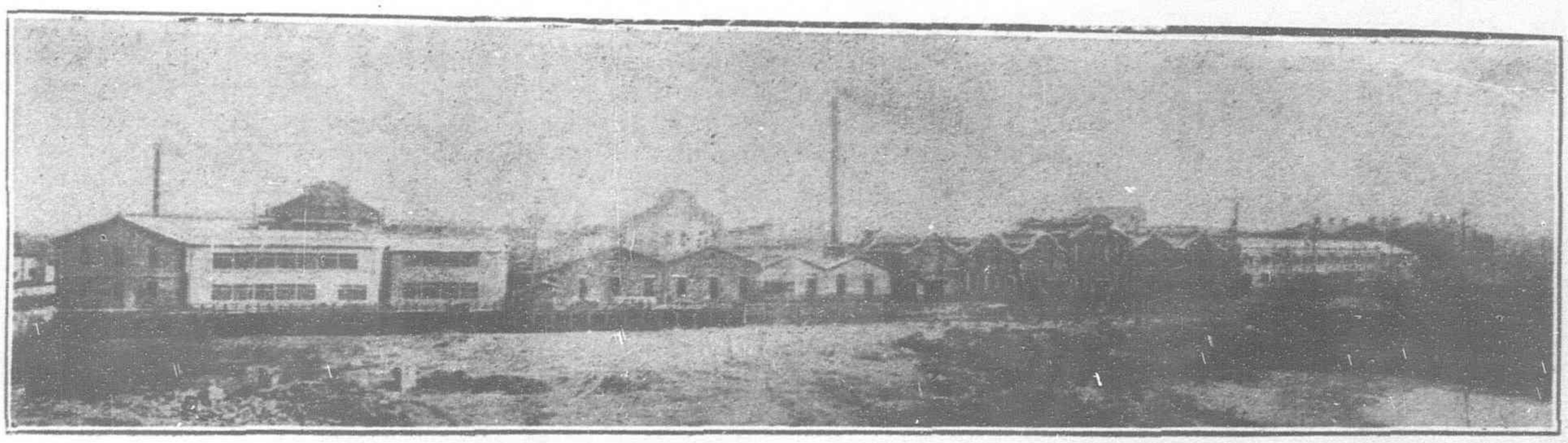
(To be continued).

Signalling Practice on the Federated Malay States Railway

(*Continued from page 767*)

39. Outlying sidings are controlled by a tablet lock fitted to the lever operating the points. In the lock is a receptacle for a tablet. When the tablet is inserted in this receptacle and the lid which confines it closed the lever is freed and can be pulled over. The instant the lever moves the lid becomes locked and remains as until the lever is returned to its normal position, when the lock on the tablet is released and it can be removed. Without the tablet the points affording access to them cannot be moved and until the points have again been set for the main line the tablet cannot be abstracted to permit the train to proceed.

40. Finally, provision can easily be made for switching through sections where required. In this manner the sections can be arranged to cover two or more ordinary tablet stations thus reducing the staff that ordinarily would be required to be on duty solely to manipulate the instruments ; on long stretches of line where mostly though goods trains are run during the night such an arrangement besides being economical assures perfect safety in the working of trains.



The Great Electric Wire Works of the Furukawa Company at Yokohama, destroyed by the fire

The Rubber Industry of Japan

Extent of Japanese Rubber Manufacture

ALTHOUGH the importance of Japan as a market for rubber goods has been recognized for several years, few realize the extent of her rubber manufacturing industry. This business has grown so rapidly during and since the war under the protection of high customs duties that exports of rubber goods now greatly exceed imports. In 1919 exports amounted to $9,689,922 against imports amounting to only $1,422,966.

On the outbreak of the war rubber goods shipments from England and Germany to Japan, China and all Far East countries were soon curtailed or stopped. The opportunity and need thus presented were quickly seized and met by Japan. New companies were organized, new factories were erected, old ones were enlarged, and the production of numerous rubber goods not formerly made in Japan was undertaken for home consumption and for export to other countries throughout the Orient where the use of rubber goods has become widespread in recent years.

Tires for bicycles, jinrikishas and automobiles, which formerly were largely imported, are now supplied to meet virtually the entire home demand and also extensively exported. The same is true of insulated wire and cable, which are playing such an important part in modernizing the Far East. Toys, balls and balloons have become important Japanese manufactures and exports, and considerable quantities of hose, sheeting, insertions, various types of shoes and druggists' sundries are also being produced.

In 1914 there were in Japan sixty general rubber companies having an aggregate capitalization of $2,500,000 and employing 4,000 hands, and eight insulated wire companies having a capitalization of $3,000,000 and employing 3,000 hands.

The following table shows the rapid development of Japan's rubber manufacturing industry in recent years:—

Year	Factories	Employes	Output in Yen*
1915...	265	5,043	6,703,796
1916...	154	7,137	11,240,169
1917...	166	6,618	15,028,864
1918...	188	8,245	22,955,559
1919...	327	11,543	32,432,324

*One yen equal $0.4985 at normal exchange.

There were also 28 insulated wire factories in 1919, employing 3,654 persons, the value of the output being 26,554,500 yen, as compared with 17 employing 1,134 persons, and having an output valued at Y.4,357,643 in 1915.

The next table illustrates the magnitude of the tire industry.

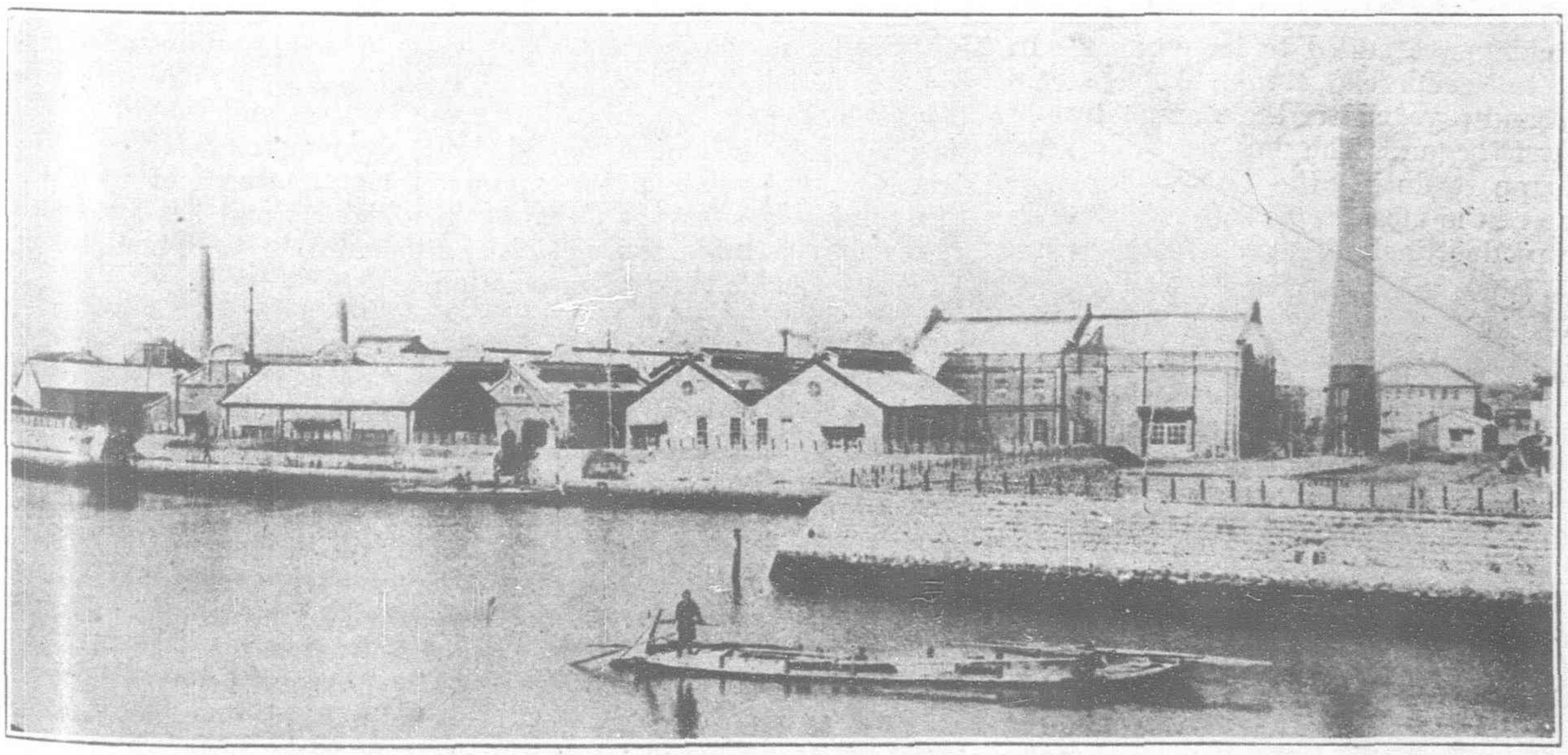
	1917 Yen	1918 Yen	1919 Yen	1920 Yen	1921 Yen
Rubber tires ...	2,176,225	4,506,000	7,114,037	8,018,064	4,478,426
Various rubber goods	614,230	1,225,000	2,510,000	1,527,000	771,979
Rubber toys, etc.	228,420	766,540	1,339,734	2,574,665	1,248,621
Insulated wire ...	3,118,000	8,324,000	8,411,700	8,043,332	3,273,092
	6,136,875	14,821,540	19,375,471	20,163,061	9,772,118

Two Rubber Centres in Japan

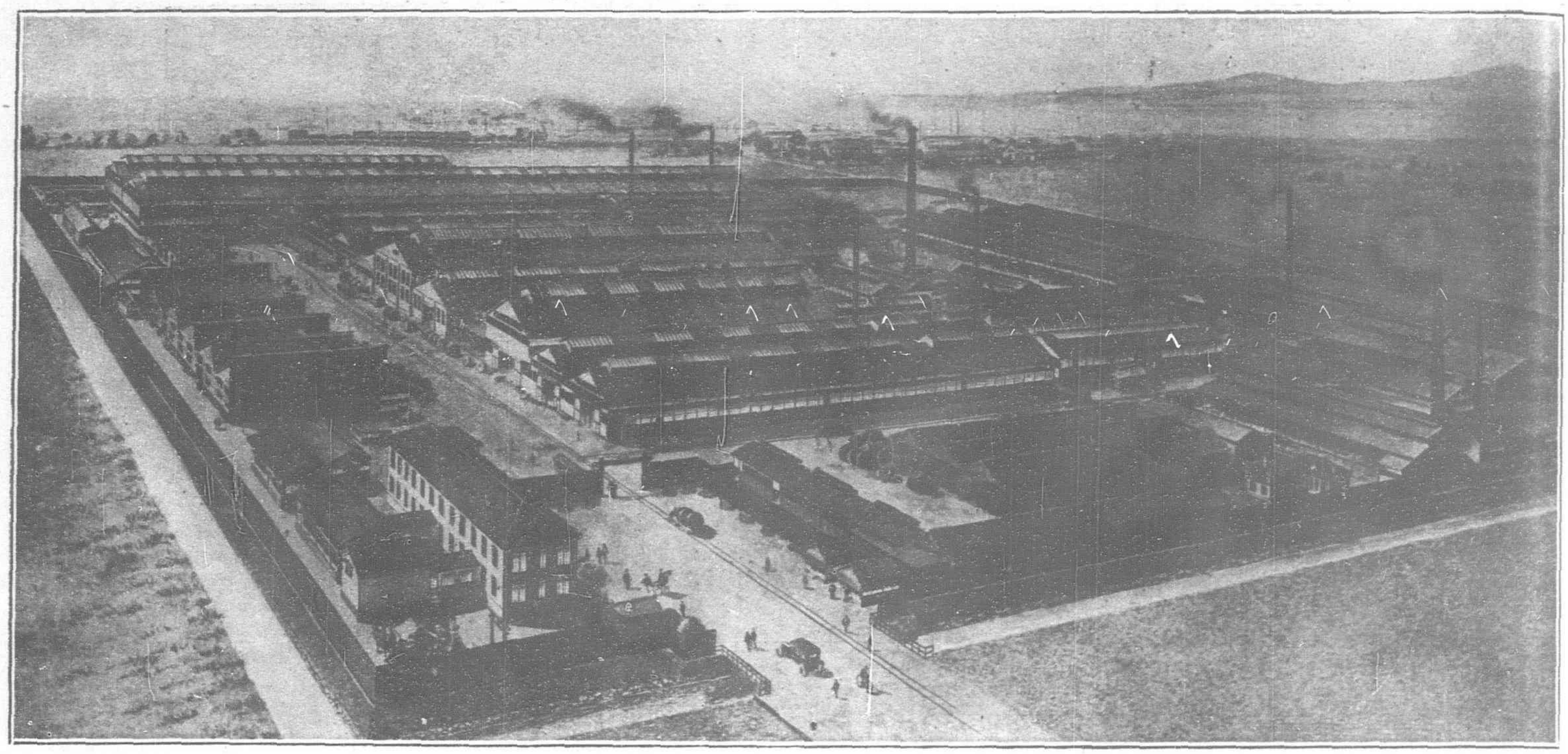
The Japanese rubber manufacturing industry has grown up in two districts about 250 miles apart, the first centring in Tokyo and Yokohama, and the second and larger in Kobe and Osaka.

The rubber plants in the latter district are intact and at capacity production can meet much of the immediate demand developed by the disaster. While many of the destroyed Tokyo plants will undoubtedly be rebuilt, several had branches in the Kobe-Osaka district which will probably be enlarged at once and in some instances may replace them permanently.

As a result, the Kobe-Osaka district, already in the lead because of its better shipping facilities and situation with respect to export markets, now promises to prosper more than ever in commerce and industry and to become the unquestioned centre of the Japanese rubber industry. It already outstrips the Tokyo-Yokohama district in imports of crude rubber, and in both imports



Osaka Branch Works of the Yokohama Electric Wire Works of the Furukawa Company



The Sumitomo Electric Wire and Cable Works at Okjjima, Osaka

and exports of rubber manufactures, although the rubber manufacturing industry of Japan began in Tokyo. As compared with crude rubber imports in 1912 of 1,023,052 pounds at Yokohama and 970,897 at Kobe, the corresponding imports in 1920 were 9,933,520 pounds at Kobe and only 3,028,855 pounds at Yokohama, these amounts being only a little over half the total imports in 1919.

Osaka is the commercial and industrial centre of the southwest half of Japan, and the chief trading place with Korea, Formosa, Manchuria, China and the South Sea Islands. Kobe, situated near Osaka, is the largest open port in the western half of Japan, and the biggest trading port of the empire. Tokyo is commercially the centre of the northeast half of Japan, and Yokohama, its port, was formerly Japan's greatest trading port.

History of the Tokyo Rubber Industry

Of the 130 rubber factories said to have been located in Tokyo in 1920, the earliest rubber manufacturing enterprise in Japan was the Tsuchiya Rubber Works, established in 1880 at Kamiyoshicho, Asakusa, Tokyo, by H. Tsuchiya and T. Tasaki for the manufacture and repair of divers' suits by primitive methods. In 1884 this business became the Mitatsuchi Rubber Manufacturing Co., and in 1889 a line of bulbs and packing was added to its product. In 1892 the factory was removed to Narihiracho, Honjo, Tokyo, steam vulcanization was introduced and a year later the manufacture of ebonite and suction hose was begun. The business expanded greatly under government support during the Chinese-Japanese war of 1894-5 and is now one of the most important rubber firms of the empire with a diverse product including tires, footwear and mechanicals.

The Nippon Rubber Co., Limited, another large concern, was established in 1900 by the consolidation of two firms with W. Yamasaki as director. One was the Yoshida Rubber Works, which had been established at Hisakata-cho, Tokyo, by S. Yoshida and W. Yamasaki in 1896, the other the Motohashi Rubber Works established at Hashibacho, Asakusa, by R. Motohashi. The plant was burned and rebuilt in 1911 and enlarged in 1915. Tires, mechanicals, especially hose, gloves, balls, belts and dolls are the principal products.

The Meiji Rubber Manufacturing Co., Kitashinagawa, Tokyo. one of the oldest and largest rubber factories in Japan, was established in 1892 as a partnership known as the Tokyo Rubber Manufacturing Co., by G. Matsumoto and S. Morita, but soon suspended business owing to the death of its engineer, Mr. Saito. In 1896 the plant was purchased by K. Kamijo, and with K. Kamada business was begun under the name of the Tokyo Rubber Factory. In 1901 the late G. Yonei bought the factory, changed the firm name to its present form and introduced European methods and machinery under the technical direction of A. T. Ferguson, an Englishman. Mechanicals, tires, balls and ebonite are the principal products.

The above companies, with the Tokyo Rubber Co., Limited founded in the early eighties by Mr. Ogiwara for the manufacture of mechanical rubber goods, are the four oldest and largest in Tokyo, and in 1920 were parties to a selling combination to complete against the Dunlop Rubber Co., Far East, Limited, in Siberian and other foreign trade.

In the production of rubber covered wire the Fujikura Insulated Wire & Cable Co., of Tokyo, was the pioneer and is now the largest producer in Japan. The business was founded in 1884 by the late Zenpachi Fujikura, who had previously been engaged at Kanda in making cotton braids and silk and cotton flexible lamp cord. Not until 1892, however, did the firm succeed, after much experiment, in producing a rubber-like insulating compound in the factory at Shinjiku, to which the business had been moved in 1886. Much credit for this development is due to Tomekichi Matsumoto, a younger brother of Mr. Fujikura and the present head of the concern. Further technical progress was largely due to the study of American methods by Kenzo Okada, a nephew of Mr. Fujikura, who returned to Japan in 1899 and installed up-to-date machinery in a new and larger factory at Tokyo. This plant was demolished by a hurricane in 1903 and rebuilt double size, only to be half burned in 1911 and again enlarged. The firm has prospered as the approved manufacturer of insulated wire and cables for the Japanese government and has succeeded in the export trade through close adherence to the standards of the British cable makers' association.

The Yokohama Rubber Industry

The principal rubber factory in Yokohama is the Yokohama Rubber Co., Limited, in which The B. F. Goodrich Co., of Akron, Ohio, is heavily interested. While the exact amount of loss sustained by this company has not been definitely stated, it is understood that the plant, one of the largest of its kind in the Orient, is practically ruined. The works cover nearly eight acres, and nearly 3,000 people have been employed. The general manager is Frank R. Carroll, former Goodrich branch manager in Los Angeles, California, who, with his family, escaped the great disaster.

The buildings of the Yokohama Rubber Co. were entirely of brick, one and two stories high, and were used for the manufacture of tires, shoes, mechanicals and othe staple rubber goods. It has a

large athletic field and various organizations for promoting the welfare of the workers. The works were established about five years ago, and, as is customary in Japan, in the directorate were included several native capitalists who were heavily interested in mining, shipping, and manufacturing. That the damaged plant will soon be rehabilitated is a foregone conclusion. It is understood that, owing to the fact that the works were situated in a low section of the city, convenient to tide-water, more injury was done by the tidal wave than by fire or earthquake.

Next in importance, and once the largest insulated wire plant in Japan, is the Yokohama Electric Wire Works, Limited, of Yokohama, which was organized in 1895 with a capitalization of $100,000 by five prominent Japanese business men of that city. Under the expert direction of German, English and American engineers the business has made remarkable growth and the works have undergone successive enlargements, despite serious fires in 1907 and 1912. In 1908 the firm became heavily interested financially in the Furukawa Copper Co., from which it had been buying its copper wire. The main works of the company are situated at Ura-Takasnimacho, Yokohama, and there is an Osaka branch. All told, there are some five acres or more of buildings comprising one of the large insulated wire works of the world with an extensive business at home and a large export trade in the Orient and Oceania.

Rubber Plants at Kobe

A little after the Russo-Japanese war, English capital became interested in the Japanese rubber trade, and the Dunlop Rubber Co., Far East, Limited, was organized in 1907. At first it imported rubber goods from the Dunlop company in England and J. G. Ingram & Son, of London, but after the revision of the customs tariff in 1911 established a tire and tube factory at Kobe. In 1917, owing to financial difficulties, the firm was placed in voluntary liquidation for the purpose of transferring the business to a new corporation under the style of the Dunlop Rubber Co., Limited, Corporation to take over all assets and liabilities of the old company and continue under the same management. Over 500 hands are employed.

The Ingram Rubber Manufacturing Co. was also established at Kobe by the son of Arthur Ingram for the manufacture of rubber goods, especially druggists' sundries.

Numerous native Japanese rubber companies have been organized in the Kobe district. One of the pioneers was K. Suzuki, founder of the Suzuki Rubber Co.

The Osaka Industry

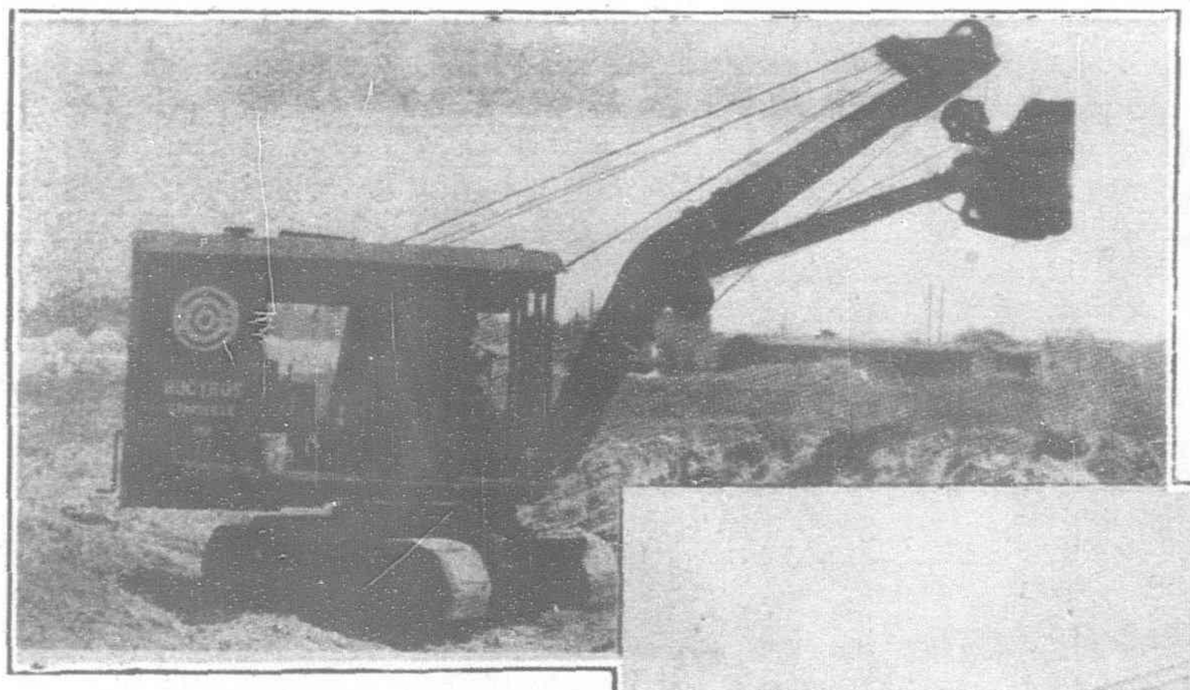
The Osaka rubber industry began in 1887 with the making of hot water bags by K. Yoshida and his associates. In 1917 there were 58 factories employing 416 men and 355 women. One of the largest of these is the Kakuichi Rubber Co., Limited, which was established in 1906 as the Kakuichi Rubber Works and in 1910 registered as a limited partnership with a capital of $100,000. Messrs. Kinjino and Ilikotaro Abe, belonging to one of the wealthiest Osaka families, are the owners. The plant was enlarged in 1917 and is equipped with American and English machinery for the manufacture of rubber rolls, plates, tubes, ebonite, tires, mechanicals, surgical and electrical goods.—*The India Rubber World.*

A New ¾ Yard Gasolene Shovel

A new ¾-yard gasoline rope-thrust revolving shovel, known as the 20-B, has just been announced by the Bucyrus Company, South Milwaukee, Wisconsin, U.S.A.

This shovel contains the same unique features which are embodied in their 30-B gasoline machine which has been on the market for the past year.

Like the 30-B, the feature which makes this machine unique among shovels of this type is the foreign ingenious rope-thrust arrangement patents on which are held by the Bucyrus Company, which not only does away with the necessity of engines, gears, clutches, chains or complicated shafting on the boom, but at the same time gives this shovel a drive behind the thrust more powerful than it is possible to obtain with a steam shovel of the same size, since the whole power of the main engine is behind it.



Bucyrus ¾ yard Gasolene Dipper Shovel: high-lift and extra high-lift booms

This device has proved itself on the 30-B shovel under the toughest digging conditions in all parts of the world, and its manufacturers believe that it has literally created in itself a new era for the small shovel, driven by an internal combustion engine.

Briefly stated, the shovel is driven by a single, rugged, slow-speed gasoline engine. The motions of the dipper handle are controlled by a small drum on a shaft under the boom, which shaft has keyed to it pinions for engaging with the racks on the handle. The drum is turned either way by two ropes wound around this drum in opposite directions, both ropes leading to drums in the main machinery.

The striking fact about the performance of this shovel is the ease with which the operator can control the motions of the dipper, even to shake it to relieve it of sticky material.

This shovel may also be had with high lift or extra high lift booms, or with dragline, clamshell excavator or crane attachments.

The control is exceedingly simple, and the machinery arranged with convenience of the operator in mind. Whatever clutches are necessary are sufficiently large to obviate the danger of burning. The caterpillars and frame in general are the same as the 20-B steam machine, which is well known for unusual strength and its ruggedness.*

Bucyrus ¾ yard Gasoline Dragline Excavator

An illustrated bulletin describing this new machine may be obtained by writing to the Bucyrus Company, South Milwaukee, Wisconsin, and asking for Bulletin F-201-S.†

*This shovel is also offered electrically driven.

†Or any of the following agents: D. Couper-Johnston & Co., Bangkok, Siam; McLeod & Co., Calcutta and Bombay, India; The Borneo Company, Ltd., Singapore, S.S.

Signalling Practice on the Federated Malay States Railways

Paper Read before the Engineering Congress at Batavia

By F. A. Punter

These notes are written with a view to explain briefly the system of interlocking in use.

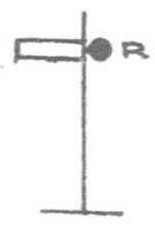
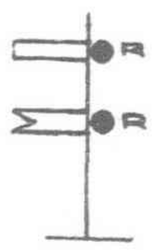
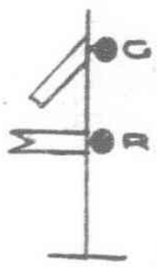
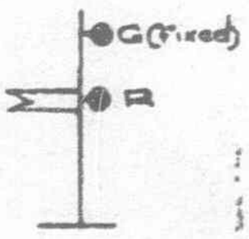
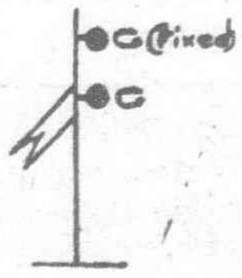
1. On double line sections of the railways.
2. Single line working.

As the system of signalling is based on the Indian scheme of signalling, it is necessary that we give the kinds of signals and their indications.

There are eight different kinds of signals. These are :

Outer Home Starting Shunt and
Warner Routing Advance starting Draw ahead or calling on.

The semaphore indications are as follows :

	Indication.	Meaning.	Explanation.	
(*a*)	Square-ended arm "off" single green light.	Proceed		
(*b*)	Square-ended arm "on" single red light.	Danger.	Stop dead, and do not pass till the arm is lowered or (at night) till the light is changed to green.	
(*c*)	Upper (square) arm "on" lower (fish-tailed) arm horizontal ; red over red.	Danger.	Stop, and do not pass till the upper arm is lowered or (at night) till the upper light is changed to green.	
(*d*)	Upper (square) arm "off" lower (fish-tailed) arm horizontal ; green over red.	Proceed with caution	Proceed cautiously, and be prepared to stop at the next stop signal or where required.	
(*e*)	Upper (square) arm "off" lower (fish-tailed) arm "off" green over green.	All right	Proceed.	
(*f*)	Signal (fish-tailed) arm horizontal ; fixed green light red.	Proceed with caution	Proceed cautiously, and be prepared to stop at the next stop signal or where re-required.	
(*g*)	Signal (fish-tailed) arm "off" fixed green light over green.	All right	Proceed.	

The fish-tailed semaphore is termed a "Warner Signal" and is similar in its function to the distant signal as used in England. The term "Warner" is distinctly appropriate inasmuch as it is intended to warn the engine driver of the condition of the block section ahead. The horizontal position of the warner signal, or the showing of two lights, one through the arm spectacle, indication "Red" and the other six or seven feet above it indication "Green," constitutes the "proceed with caution" signal. The lowered position of the arms or the showing of two green lights one above the other, constitutes the "all clear" signal, and signifies that the next block section ahead is clear. The exhibition of a red over a green light, or the corresponding position of the arms by day, or the absence of one or both lights, shows that the signal is out of order and it must be treated as a danger signal.

2. The outer signal is really a repeater of the home signal worked by an independent lever and so interlocked that the home signal must be "off" before the outer can be lowered. Where a warner signal exists it is placed on the same post. This is a stop signal.

3. The home signal is the first stop signal of a station at which a warner is provided, and the second stop signal of a station at which an outer is provided.

4. The track or routing signal is a special bracketed signal used to indicate, to an engine driver, which of the two or more diverging tracks he is to travel over when the home signal is, in consequence of its position, inconvenient for that purpose.

5. It is not permissible to place home signals for diverging routes one below the other. They must be placed on separate posts or they can be on short posts termed "dolls" carried by a bracket or signal gantry. In arranging signal arms on a bracket or gantry "Stepping" is employed as much as possible ; the relative height of each doll is an indication to the engine driver of the number of turnouts he has to take and the speed at which his train must be controlled. In principle the more important signals are higher than the less important ones. This "Stepping" of signal arms is a great advantage in enabling an engine driver to pick out his signals as at night should there be a row of lights all on the same level it is by no means easy to decide at a glance to what direction any particular signal reads. Practice in "stepping" varies on different railways, but a difference in height of 3-ft. or even of 2-ft. where there are many signals to deal with makes a good and readable distinction.

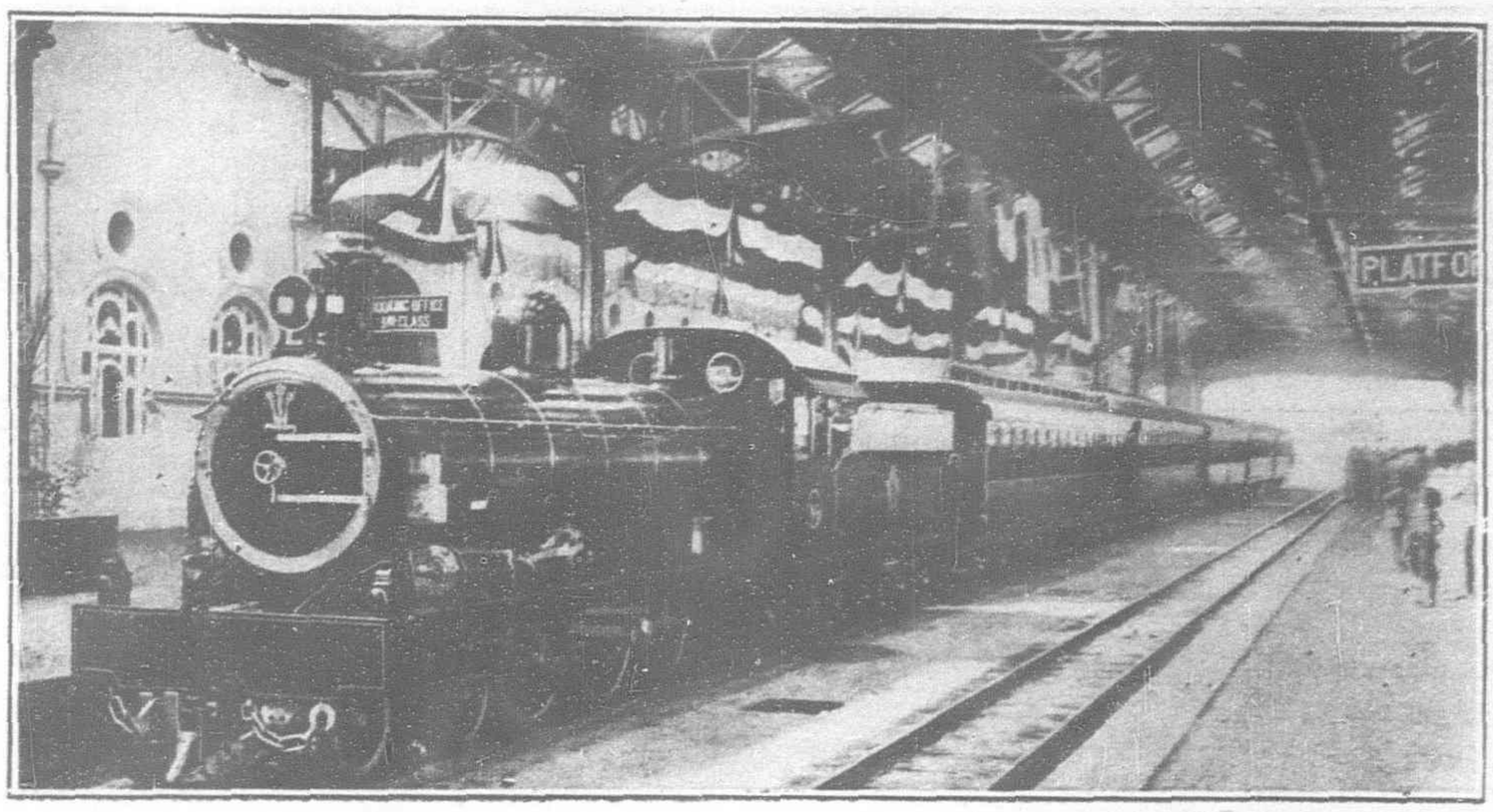
Figures 1 is an example of such a signal bracket and gantry.

6. The stop signals which control the movement of trains leaving a station are of two kinds "Starting" and "Advance Starting" signals. If only a starting signal is used it will control the entrance of a train into the section ahead. When, however, in addition to the "starter" an "Advance Starting" signal is provided at a station the "starter" loses its importance to a great extent and becomes on intermediate STOP signal, and in this instance it is the advance starting which controls the entrance of a train into the section ahead. A train having passed the advance starting signal comes under the direction of the signalman ahead.

7. Draw ahead or calling on signals are short semaphores placed on the same post and below a starting or advance starting or home signal arms, and when lowered indicate to the engine driver to "draw ahead" although the main signal is in the "on" or danger position, for shunting purposes only.

8. The movements of trains or engines between sidings and the main tracks and between one main track and another are controlled by ground signals. There are several types of ground signals. It is the practice on these railways to govern all such movements by miniature semaphore signals which conform to the indications exhibited by running road signals.

9. The foregoing are the signals commonly used for main line working. Occasionally, however, the names used are not sufficient to classify all the signals employed and in the circumstances special names have to be assigned to the signals to meet the situation. In all signals the semaphore is placed on the left-hand side of the post and the "proceed" position is given only when the arm is inclined downwards from the horizontal.



Royal train on the F.M.S. Railways conveying H.R.H. The Prince of Wales on his visit to the F.M.S. in March 1922

10. The system adopted is that known as the "manually controlled." Figure 2 is an illustration of a type of a signal cabin. It will be observed that exhibited in front of the cabin are two plaques inscribed "S" and "T" denoting respectively "Signals" and "Telegraphs." It is the duty of signalman when a failure takes place to reverse the plate and so attract the attention of the linesman or signal fitter as the case may be should he be in a passing train. The failure of course is reported to the section headquarter in prescribed form at the same time.

11. Lower quadrant indicators are used with the semaphores working through an angle of 45 to 60 degrees with the horizontal. The majority of the interlocking frames are of the direct or lever locking pattern that is, the pulling of the lever operates the locking. Another type is known as catch handle locking, in this type of frame two driving plungers or tappets, are fitted one above the other in the locking box. One plunger is connected directly to the lever, but very low down. The upper plunger is connected to the catch handle, and this plunger actuates the locking. If the lock cannot move, the catch cannot move, hence the lever is locked. The bottom plunger registers the correct position of the lever.

12. Figure 3 depicts a view on one of the large station yards. The principle of interlocking is so well known as to need no repetition; it is sufficient to state that all positions of signals are in accordance with board of trade requirements, and the interlocking in the lever frame in the words of the board of trade is such, "that the signalman shall be unable to lower a signal for the approach of a train until after he has set the points in the proper position for it to pass; that it shall not be possible for him to exhibit at the same moment any two signals that can lead to a collision between two trains, and that, after having lowered the signals to allow a train to pass, he shall not be able to move any points connected with, or leading to, the line on which the train is moving." Under Indian signalling practice there are three distinct classes of stations:—A, B and C.

Train Central Office, F.M.S. Railways, Kuala Lumpur

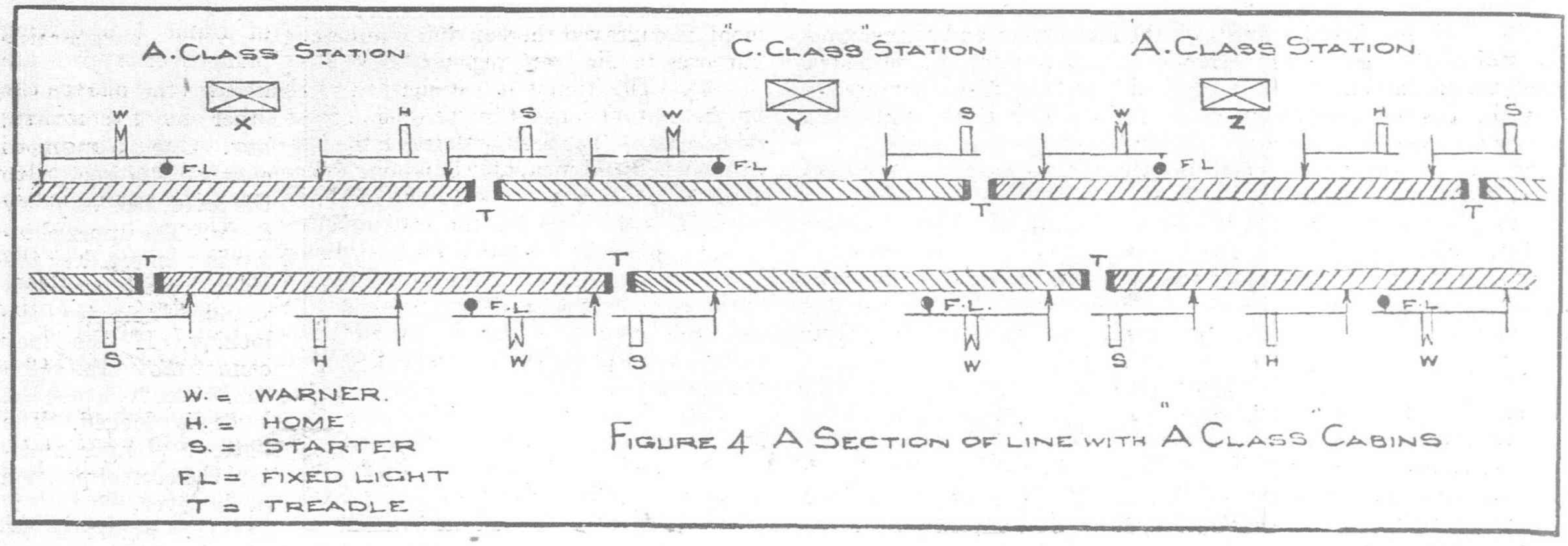


FIGURE 4 A SECTION OF LINE WITH A CLASS CABINS

"A Class" Station

13. The absolute block system is the only system used for working traffic, and may be defined as a method by which the traffic on a line of railway is so regulated that one train or engine only shall be in any one section, and upon the same line of metals, at the same time. To effect this it is necessary to devide the line into two lengths, each such length is termed a block section.

14. In " A Class " stations there are three essential signals, warner " with fixed green light above it " the home, and the starter.

15. Figure 4 shows a section of the line with three " A Class " signal cabins at X. Y. Z. As the purpose is to denote the several block sections only, points and crossings which would ordinarily intervene between the home and starting signals are not shown on the diagram.

16. The block section is shown by the etched lines and is the section of line from the starting signal at one station to the starting signal at the next station. At T on electric treadle is fixed the functions of which when actuated are :—

1. To release the back lock on the starter.
2. To release the lock on the instrument thereby permitting the signalman to give line—clear for a following train.

"B Class" Station

17. The " B Class " station Figure 5 differs from the " A Class " in two important respects.

1. An extra stop signal is provided above the warner arm.
2. The block section extends from the starting signal in the rear to the starting signal in advance.

18. The provisions of this additional stop signal termed the " outer home " or, for short the " Outer " enables more traffic to be worked over a section than is possible with traffic worked under the " A Class " system. With " B Class " working it is permissible for B to have a train standing at his platform and, at the same time, give line clear to A for a second train to approach. He cannot, however, lower his outer signal to admit it until the first train has left his station and passed over the treadle in advance of his starting signal. In long sections this is a distinct advantages looked at from a traffic point of view. The section between the outer and home signals is always " dead " as the outer is released by the home.

19. Circumstances, of course, will decide whether " A Class " working or " B Class " working will prevail. Although, from what has been written, it is shown that " B Class " working is preferable. " A Class " may have to be adopted where the stations are so close together that a long train standing at an " Outer " would foul the section in rear.

20. There are many ways in which the locking of levers can be arranged in lock and block working. In the diagram Figure 5 both the home and starter levers would be provided with electric locks, and, if necessary, reversers on the signals as well, so that the train in passing over the treadles T & T 2 would put the signals to danger as well as releasing the locks on the levers working the signals. Any conditional locking that may be required can easily be arranged for.

"C Class" Station

21. Instances occur when it is necessary to break up a block section between two stations operating under " A Class " working ruling. To meet this condition the type of signalling shown in Figure 4 has been introduced. Two signals only are provided, a warner and a stop dead signal, which combines the functions of both the home and starting signals. This constitues the " C Class " station. The signals are mechanically operated and block instruments of similar pattern are provided. A treadle is fixed ahead of the starter to effect the release of the instrument and signal.

22. The block instruments used are of the one wire three indication type worked by momentary currents. Although these instruments are arranged for lock and block working it was not considered necessary for the full complement of lock and block signalling being installed at present. Trains are therefore worked on the block system.

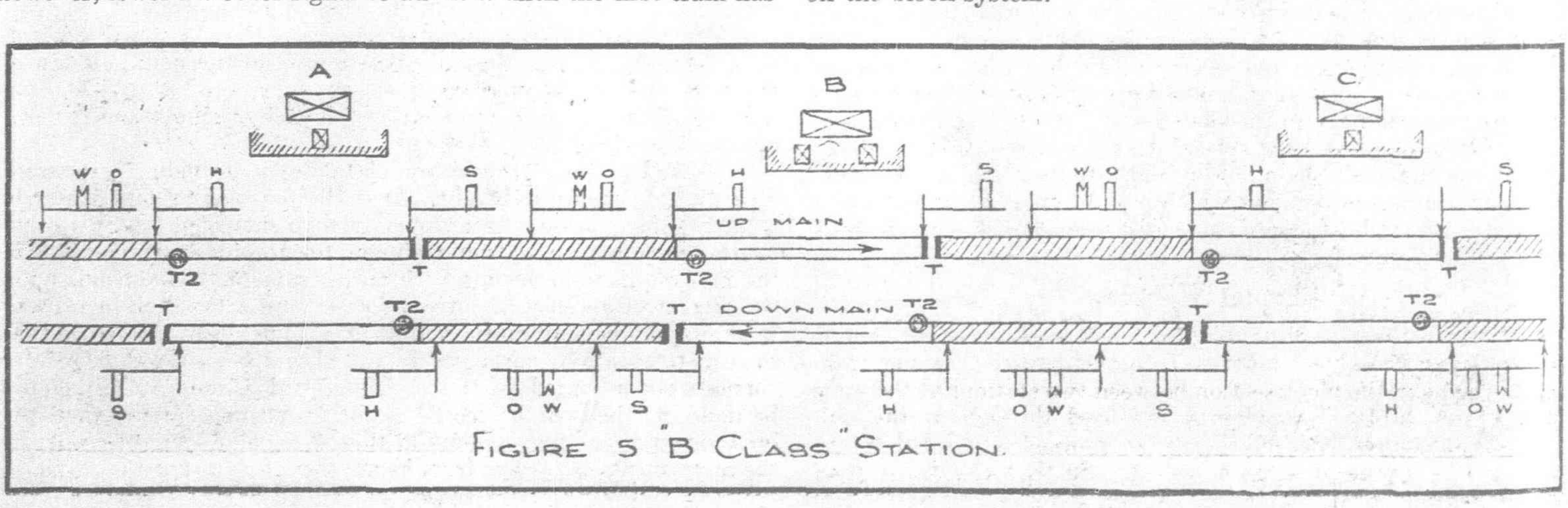


FIGURE 5 "B CLASS" STATION.

23. Figures 6 and 7 illustrate the instrument and connections. The working is as follows: In the normal position of the instrument the needles show "Line Blocked" and the first commutation from this position sends a current of full strength to the line. This causes the needle to traverse the full distance and show "Line Clear" at the same time operating the armature of the line relay which closes the bell circuit.

24. The next commutation sends a current of reverse strength to line, which also operates the armature relay fully but does not allow of a complete traverse of the needle in the reverse direction, owing to the cave of small locking coil checking the cylinder and allowing the needle to occupy a central position showing "Train on Line."

25. The third and final movement of the commutator splits the current, short-circuiting three-fourths of it through the lower locking coil and operating the armature, allowing the needle recording "outgoing" currents to show "Line Blocked" at the same time the remaining current of one-fourth full strength is sent to line, this current being too weak to operate the armature the full distance attracts it to the moveable arm; this, in addition to closing the bell circuit, operates the upper locking coil, the armature of which engages with the cylinder of the "receiving" needle is lifted, the needle is freed, thus allowing it to traverse the remaining distance and show "Line Blocked."

26. The commutator is interlocked with the plunger and is so arranged that when the commutator is turned from one position to another no further movement can take place until the plunger is pressed home and the signal recorded, when the commutator is again free. The commutator can only be turned in a clockwise direction. A small plunger is fitted below and to the left of, the commutator; this plunger requires to be momentarily depressed in order to free the commutator when the latter is turned, as the commutator is locked in each position against a retrograde movement. In the illustration, the upper needle mounted on the dial plate is the block signal governing trains proceeding to the next station and is worked therefrom. The lower needle is operated by the outgoing current of the station at which the instrument is fixed, and forms a reflex of the signal last sent for trains approaching. The commutator has a segment painted to correspond with the inscriptions on the dial, which appear at the operature above the commutator, and form together with the position of the lower needle and index of the condition of the instrument.

Single Line Working

27. Plate 8 shows the layout of a yard and signals at what we term a wayside station. The signalling is on the same principle as that employed throughout the system. Instead, however, of a signal cabin controlling the working of the points and signals we substitute a platform ground frame (Figure 9) which is operated by the pointsman under the supervision of the station master.

28. On reference to the diagram it will be observed that a starting signal for each direction is not provided. Inasmuch, however, as the tablet is the engine driver's authority to proceed into the section ahead a starting signal, if provided, would only amplify that authority; it was therefore decided by the general manager, railways, that at wayside stations starting signals should be dispensed with. Under these circumstances and to avoid the risk of the trailing points being run through, the locking is so arranged that, supposing a down train is to be accepted into the loop line, it is necessary to "set" the trailing points to the loop line before being able to lower the incoming signals. Such a procedure is, in the absence of starting signals, necessary to avoid over-running and consequent damage to the switches.

29. Point indicators of special design are fixed at the fouling point of the main and loop lines to indicate the "lay of the road" and to determine the point at which a train must be brought to a standstill. The indicators are connected to and work with the rods actuating the points.

Tablet Working

30. As in the case of double line block working so with single line working. The object must be to prevent more than one train or engine being in the block section between two stations at the same time. Tyer's tablet instruments are used throughout the railways. The "Line Clear" authority to proceed is handed to the driver in the shape of a metal tablet. So that the driver may know he has the correct tablet the section governed by the instrument is engraved thereon and numbered, the latter for registration purposes in the train register book.

31. The tablet is automatically released by the instruments by the mutual consent of the operators at either end of the section. After a tablet has been withdrawn the instruments remain automatically locked and incapable of issuing a second tablet, until the tablet already issued is restored to one or the other of the issuing instruments by which means the instruments are released by electrical impulse and again capable in th eordinary course of issuing another "Line Clear" tablet. It is thus ensured that two "Line Clear" authorizations for trains to proceed in the opposite or following direction cannot be issued. A matter which it is impossible to ensure when paper "Line Clears" depending on the intelligence of the operator are used.

32. In the pattern of Tyer's tablet instrument shown in Fig. 10 are two drawers or slides. The top one which receives the tablets and the bottom one which issues them. Normally both slides are in the closed position and the visual indication of both the instruments at "A" and at "B" is "Line Closed." In this position it is open to the operator at either the one or the other end to ask for line clear, and the operator if he is ready to receive a train signifies his assent by repeating the "Is Line Clear" signal on his bell. Assuming a train to be going from "A" to "B" the sequence of operations is as follows:

33. When the "Is Line Clear" signal is repeated "A" depresses his bell plunger for a few seconds, this causes the needle in "B's" instrument to deflect and "B" must then hold down his switch plunger and at the same time withdraw his lower slide half way. The withdrawal of the slide halfway changes the visual indication from "Line Closed" to "Up Train Approaching." "B" then intimates on the bell to "A" to release his switch plunger. Next "B" will depress his bell plunger, keeping it depressed for a few seconds "A" then depresses his switch plunger and at the same time withdraws his bottom slide right out to the full extent and so obtains a tablet. The visual indications is again altered and now reads "Up Train On Line."

34. On the arrival of the train at "B" the tablet is restored to the instrument tablet chamber by pulling out the top slide inserting tablet thereon and pushing the top slide in. This movement unlocks the bottom slide, which is forthwith put back. Putting back the lower slide restores the visual indication to "Line Closed." The train out of section is then given on the bell to "A." "A" on receipt of this signal depresses his switch plunger and at the same time closes his lower slide, thus changing the visual indication in his instrument to "Line Closed." "A" signifies to "B" on the bell that he may let go his bell plunger. This ends the operation and the section is again closed as indicated by the visual signals on both instruments.

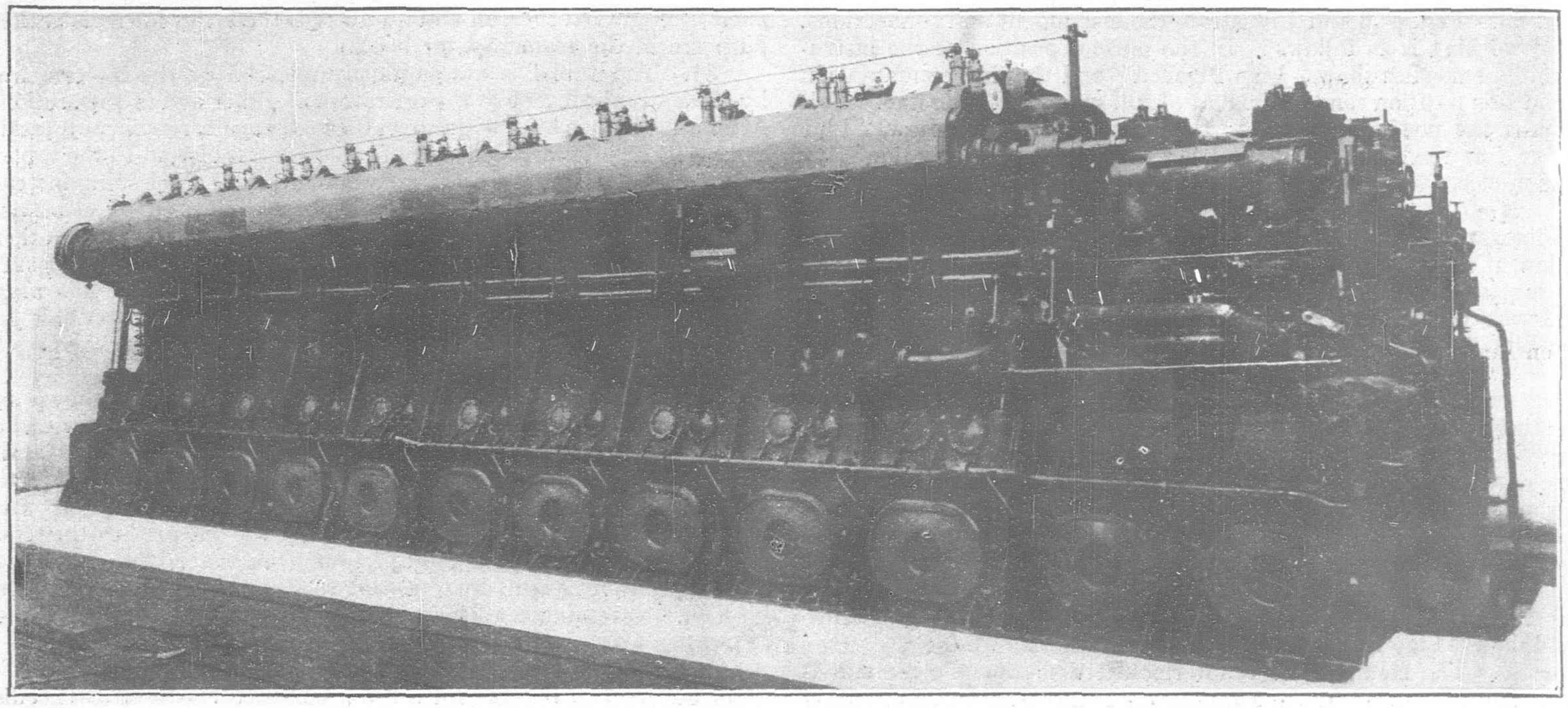
35. It will be observed that the instruments ensure by means of the visual indications a record of the condition of the tablet at each end of the section. Such a record is undoubtedly of great advantage. The operator is inspired with confidence when he sees what is passing at the other end of the section.

36. The tablets for the instruments are made to template in order to ensure perfect fit and avoid friction in the tablet chamber. Their configuration, however, differ. The object is to prevent all possibility of a wrong tablet being inserted in an instrument. The notches in the rim of the tablet are those which are required to correspond with the instruments to which they apply.

37. From the diagram of connections Fig. 11 it will be seen that currents of opposite polarity are used in the manipulation of the instruments thereby eliminating any risk of a tablet being snatched from either instrument by a breach of regulations governing block working.

38. The utmost precaution is taken in providing a separate "earth" for each instrument. It is the practice to have common "earth" for various telegraphic instruments, but block instruments are things apart from ordinary telegraphic instruments, and the first requisite in dealing with an instrument that depends upon the receipt of an electric current for so vital a function in railway working as the automatic release of a "line clear" is to see that such instruments are properly insulated and not subject to receive currents not intended for them. Where this is done, and it should be done, a "bed earth" could result in nothing further than the breakdown of the instruments in that particular section, rendering the instruments powerless from harm, though delaying the traffic.

(Continued on page 760.)



3,000 B.H.P. Ten Cylinder Four-cycle M.A.N.-Diesel Marine Engine

The Diesel-Engine Meeting of the Verein deutscher Ingenieure, Berlin

ON June 29 a meeting much frequented by visitors from abroad took place in the house of the association of German engineers under the management of its scientific council and its chairman Dr. *Lippart* Geheimer Baurat of Nuremberg; the topic of the meeting having been the discussion of the present status of the Diesel-engine and the problems connected with its development. The great importance of the Diesel-engine as a prime mover has been reflected at this meeting not only by the mere arrangement of it through the verein deutscher ingenieure but also by the rich contents of the chief lecture and the reports annexed to it. These reports representing a true picture of the present status of our knowledge on this territory, might be of great interest to numerous engineers.

At first Prof. Dr. *Nägel* of the Dresden technical high-school delivered his lecture on

The Diesel-Engine of the Present Day

Starting from the paper, which has been delivered by the speaker in 1911 on the chief meeting of the verein deutscher ingenieure in Breslau about the status of the development of the Diesel-engine at that time, he traced the further development of this prime mover in meantime to four principal directions which have been discussed in detail by the aid of characteristic examples principally from the German machine building industry. Those four fundamental lines of development refer to :

(1) The design of the engine and its adaption to economy of material and high number of revolutions.

(2) The introduction of the two-cycle-process instead of the four-cycle-process.

(3) The change from the compressed-air injection of fuel to the solid injection in the Diesel-engine without compressor.

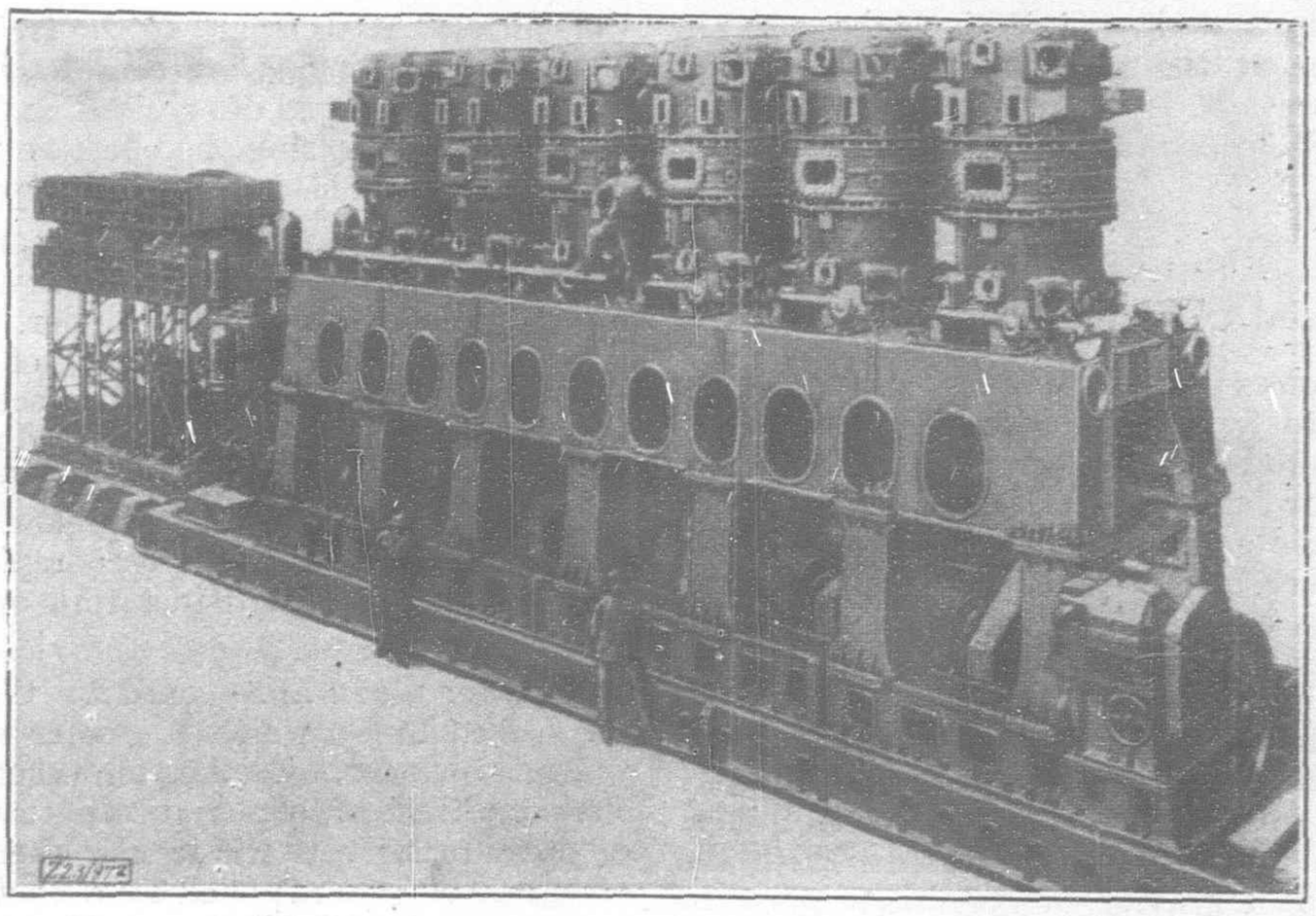
(4) New measures for realizing an irreproachable combustion of heavy combustibles in the Diesel-engine.

Referring to the first point, the paper discussed the new design of the *engine frame*; valuable experience has been gained about that with the high-speed engine of the submarine which has been more or less utilized in the construction of all present-day Diesel-engines. In the construction of the Diesel-engine care must be taken very often of the cheap production in great lots; this point of view being for instance decisive in the building of the small powered engine which is made in series. As far as the great Diesel-engine is concerned which in first line is used as a marine engine to a steadily rising degree, the economy of construction materials and space maintaining at the same time security on service and thermal efficiency being of paramount importance. By the aid of examples supplied by the firms of Maschinenfabrik Augsburg-Núrnberg, Gebr. Sulzer of Winterthur and Ludwigshafen, Fried. Krupp A.-G., Gemaniawerft, of Kiel, Werft Kiel of the Deutsche Werke A.-G., Allgemeine Elektricitats-Gesellschaft of Berlin among others, the features of construction of the engine in question have been discussed and finally the Michel-Motor has been mentioned built by the Michel-Motor-Gesellschaft m.b.H. of Kiel, representing a new form of the Diesel-engine with stare arrangement of cylinders capable of great development.

In adapting the *two-cycle-process* to large engine-units the two-cycle-valve-scavenging engines have been the starting point, followed by the slot-scavenging two-cycle engines which as marine engines are expected to supply sufficiently large cylinder units. For the first time mention has been made of the 12,000 h.p. two-cycle engine built by the Nuremberg workshop of the Maschinenfabrik Augsburg-Nürnberg for the German admiralty in 1910 after much pioneer work, which engine has been destroyed on account of the peace treaty after successful and highly promising trial runs. In the construction of the valve-scavenging engines the Germaniawerft joins as well; this shipyard has constructed the well-known tankship *Zoppot* and has equipped it with two 1,700 h.p. two-cycle engines; this vessel has given much result in this line after many years' experiences. In changing over to the slot-scavenging engine Messrs. Gebr. Sulzer of Winterthur and Ludwigshafen have rendered pioneer's services; they have supplied till now many marine engines of this design up to 3,000 h.p. of effective output. Excellent trial results with an entirely new engine of the Ludwigshafen works of Messrs. Gebr. Sulzer have been made known by the lecturer; by these results the two-cycle process has been placed, as far as the fuel consumption is concerned, with the four-cycle process on one and the same level for the first time. The Augsburg establishment of the Maschinenfabrik Augs-

burg-Nürnberg, after a long trial work, has recently developed a new two-cycle method, which in first line is intended for double-acting cylinders of largest dimensions and has given much promising results on trial engines.

The *compressorless or colid-injection Diesel-engine* has become of an extremely great importance for the present small engine and has taken a corresponding many-sided development. The omission of the compressor has become an economical necessity for the small Diesel-engine and there are even justified views to run the large Diesel-engine gradually without compressor as well. The different designs and methods in question have been compiled by the author in a definite system and discussed by the aid of characteristic examples taken from the Moterenfabrik Deutz, the Germaniawerft of Kiel, the Maschinenfabrik Augsburg-Nürnberg and the firm of Gebr. Sulzer of Winterthur.



Most powerful Diesel-engine ever built: M.A.N. double-acting, two-cycle, six-cylinder engine of 850 m.m. cylinder diameter; 1,050 m.m. stroke, 160 r.p.m, and 12,000 nominal H.P.

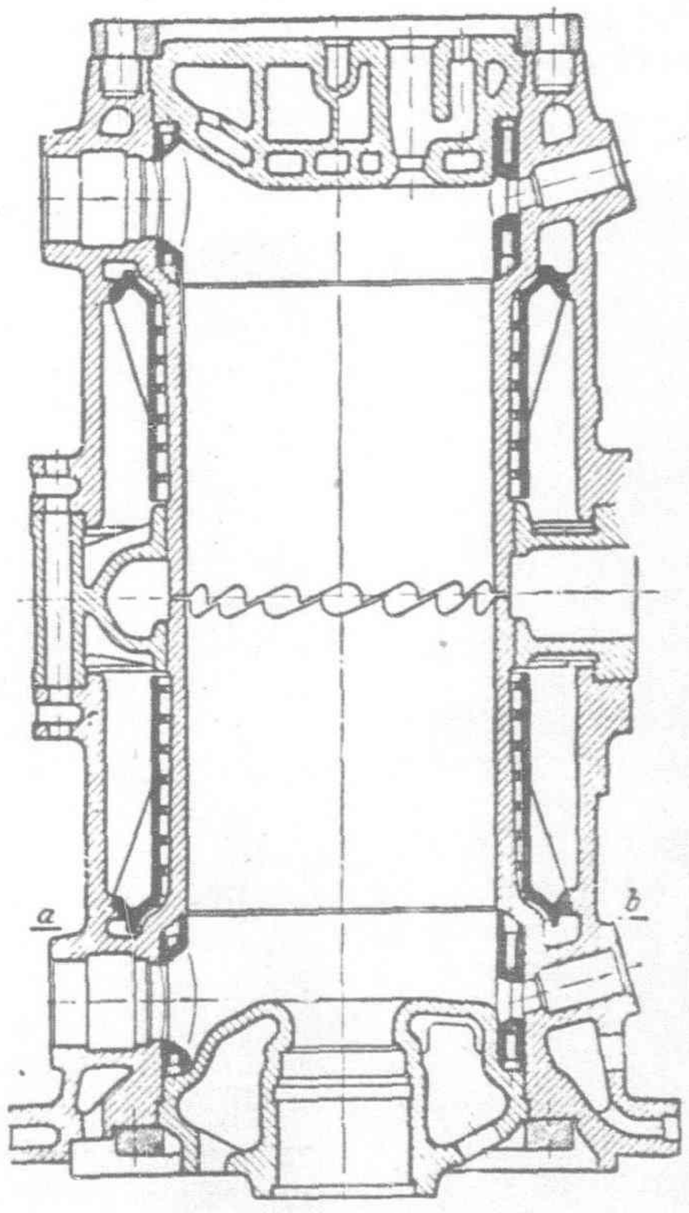
As to the utilization of *hard boiling combustibles* in the Diesel-engine the inventive endeavors in Germany has got no economical incitement during the last years because the price of the inland coal tar oil has not been so much less than the price of the gas oil and brown coal tar oil to justify from the economical point of view any applications of the hard boiling coal tar oil. Not till recent days thick oils derived from petroleum have been brought on the market from abroad which might resuscitate the work of inventors on this line. The only step forward besides the knowledge of the two-cycle engines being especially well fit for the safe utilization of hard boiling combustibles without further measures, might be the piston design as has been developed by Messrs. Krupp. During interesting trials made in the Essen works it has proved to be an excellent means to enable to use exclusively coal tar oils even at no-load conditions of the engine.

The lecturer finally mentioned the application of the Diesel-engine to the drive of locomotives and exposed the solution which has given to this problem much discussed before the Linke-Hofmann-Lauchhamer-Werke of Breslau making use of the Lentz hydraulic gear.

After the lecturer Prof. Dr. Ing. W. *Nusselt* of Karlsruhe read about the

Transition of Heat in the Combustion Engine

The speaker informed of tests which he has carried out with ball-shaped bombs for studying the cooling of hot gases. The heat passes into the cold wall of the bomb partly by heat conduction and partly by radiation of heat. In order to separate the whole transmission of heat into both elements, the lecturer has made use of bombs blackened on the inner surface on the one hand and of those gilded within on the other hand. The difference of delivery in both cases being proportional to the radiation of heat of the hot gases of combustion. It has been shown that the radiation of heat from hot gases follows the Stefan-Boltzmann law of radiation, that is to say, that it increases with the fourth power of the absolute temperature, but on the other hand it has been also shown that the amount of radiation by hot gases is only about $\frac{1}{15}$ of the radiation by the absolute black body of the same temperature. The heat delivered by conduction depends on the temperature and on the pressure. By making use of the tests of Clerk with a gas engine the influence of the travel of piston upon the heat given up has been taken into consideration. Applying the new formular to the delivery of heat in the combustion engine, it will be seen that radiation of gas does by far not play the part ascribed to it formerly and that it suffers besides strong alteration during one travel. The assumed dependence of the coefficient of heat transition on the mean piston speed is certainly only an approximate, it being desired that more exact tests will soon give further data about the heat transition coefficient in engines.



Section through working cylinder of 12,000 B.H.P. two-cycle M.A.N. Diesel-engine

After this speaker Prof. Dr.-Ing. *K. Neumann* of Hannover reported on

Comparative Tests about Compressed-air Atomisation and Compressorless Service in Internal Combustion Engines

The speaker treated at first the difficulties which are encountered at the change from air injection to mere pressure injection with heavy oil engines according to the Diesel method and demonstrated by the aid of an example that airless injection under equal conditions requires extraordinarily high pump ressures and very small nozzel diameters. He further reported on trials with compressorless engines of different cylinder-sizes at different numbers of revolutions. The combustion in these engines has been attained by the methods of generation of eddies through the working piston or with the aid of an ignition chamber and the engines ran with light petrol, with gas or with coal tar oil. All figures necessary for judging the working process have been carefully measured at these tests.

In comparing the different methods of operation carried through, on account of the test results, it is remarked that the oil engine of the new institute of internal combustion engines at the technical high school of Hannover has been used throughout the trials and thereby any influence of the engine design on the results of the tests has been excluded. The results of the tests show the speed of combustion of the different oils within the running engine, all phenomena influencing the diagram and their reasons. It is shown that with high-pressure oil engines several ignitions will always occur and further, that it is of high importance that the first partial ignition takes place in due time and at the desired place. By a calorimetrical investigation of the different engines the value of temperature is determined with air injection and compressorless operation during the periods of combustion and expansion and in connection therewith the heat is found out which passes to the cooling water during those phases. It ensues from that that the mean figure of transmission of heat will be greater with compressed-air

atomisation than with compressorless injection, because in operating without compressor at the time of ignition a lower degree of the addy currents prevails.

After this lecture Dir. *F. Schultz* of Cologne-Deutz spoke on the

Guide Lines for the Series Manufacture of Small and Middle-sized Oil Engines

Growing competition forces to manufacturing engines in great quantities. In order to facilitate the series manufacture, it is necessary to restrict the production to narrow working spheres and to maintain a strict standardization, to use few sizes of cylinders and to try to obtain intermediate output by changing the number of revolutions and the number of cylinders. An important expedient will also be to fit the engine body for different uses, for different kinds of cooling and for different combustibles. All parts of different types must be standardized.

The series engine must be simple of construction, effect and details. Plainness is the equivalent of security on service, easy handling and, above all, of quality. By low weight and short routing through the factory, production is increased. With the series-manufacture the centre of gravity of operations must be placed at the beginning of production and the construction of the engine by the aid of partial units of separate make and control must be aimed at. Wrong measures in design and manufacturing methods which can be repaired at the construction of large engines will be generally of catastrophal consequences with the series-manufacture.

Further, chief-engineer *Alt* of Kiel spoke about

Combustibles and their Combustion in the Diesel-Engine

This topic treats at first the most important chemical and physical features of the liquid combustibles as the basis for judging their suitability for the Diesel-engine, accentuating the new efforts to adapt the engines especially for the low-valued combustibles. As the utilization of such combustibles is only possible by the Diesel-engine at present, this gains a special importance as compared with other internal combustion engines. This being the reason of its increasing use and especially in the shipbuilding industry.

The speaker then treated *in extenso* the theories on the phenomenon of combustion within the Diesel-engine, based on recent investigations. Our knowledgee gained in this way have not alone a mere theoretical value, but they are of great practical importance as well, enabling us to draw the points of view for the design of the Diesel-engine therefrom, with the aim to burn any liquid fuel imaginable.

All former ideas about the phenomenon of combustion, viz., the ignition of the combustible injected into the strongly heated air being preceded by vaporization to a certain degree and further, the different behavior of combustibles in the engine must be described to the differences of their behavior during the vaporization, opinions, which we find generally adopted to-day, must now be given up. On the contrary, it can be shown that the atomized combustible ignites directly, that is to say ignition is not preceded by vaporization and not even by a vaporization worth mentioning. The behavior of combustibles during those phenomena is due in first line to their chemical (molecular) constitution and to be traced to the self-ignition temperature within the engine defined by that constitution which is decisive in the first line. Combustion must further be carried through in such a way that no vaporization of combustible occurs as far as possible, because decompositions connected with it might cause the formation of soot and therewith a poor combustion.

To prove the correctness of these new opinions the speaker referred to the fact that the Diesel-engine can be driven even with the most obstinate of all combustibles, viz. with unmixed benzole, if conditions necessary for its due combustion be drawn into consideration.

Furthermore, chief-engineer Dr. *Riehm* of Augsburg informed about

Increase of Output with Four-cycle Engines

Development calls in the construction of oil engines as well for engines of more and more great output. Here mastering of the heat efforts of the large cylinders rises, as it is known, the most difficulties. With regard to the fact that those heat stresses with the four-cycle engine are considerably lower than with the two-cycle engine of equal dimensions, and investigation of the question, whether by increasing the effective piston pressure with the four-cycle engine can lead to greater output will be of special interest.

The effective piston pressure can be increased in a simple manner by introducing a greater quantity of combustible into the regular air charge of the working cylinder. The problem of burning this combustible in the given weight of air as completely as possible requires a greater energy of injection either by increasing the pressure of blowing in or by feeding additional atomisation air through a special valve. Test of this method have shown, however, that with increasing piston pressure both the fuel consumption and the heat stresses increase rapidly. This method, therefore, can be drawn into consideration only for temporary increase of output.

Better views are opened by the method to precompress the air sucked in by which a greater air weight is carried into the working cylinder. Combustion takes place approximately between the same limits of temperature, eventually, between the same limits of pressure, as with the regular engine, as well. The previously-compressed air is supplied by a blower. As tests have shown, increase of output of 30 or 50 per cent. can be obtained by this process without a considerable increase of the specific consumption of fuel. Heat stresses of walls increase in a low degree only. Even more favorable conditions result if one succeeds to utilize the energy of exhaust gases for driving the pre-compressor-plant, that is to say to connect the centrifugal compressor directly with the exhaust-gas turbine. This solution which have been tried already with great success with flying engines for great heights might offer good views with the Diesel-engine as well and justify further tests.

Finally Dr. *Geiger* of Nuremberg spoke aout

Long-distance Actions of Power Engines

Among the long-distance actions issuing from power engines vibrations inside of dwelling houses play a great part, as it is known. Those vibrations are caused by free forces, moments, etc. Although there is no danger of cracks with the regular buildings, men provides with sensible nerves are frequently disturbed of their well being. In order to find out those vibrations as to their nature, besides the very sensible seismograph, the vibrograph of the author is very suitable, which is furnished by Lehmann & Michels of Hamburg-Wandsbeck. Experience has shown that the sensibility of this measuring instrument, the writing pencil of which records vibrations on a continuous paper slip, goes as far as the sensibility of the human nerves that is to say it is adequate for the requirements ot practice.

In order to prevent such long-distance actions, engines with great free mass-forces must not be placed in the neighborhood of inhabited houses with several stories on small area, because these fall very easy into resonance with the ossillation of the mass-forces and we have known by experience that the resonance causes the greater part of disturbances. Attention must be paid to the building site as well which must be reinforced by piles eventually.

There are a number of expedients to remove vibrations: removal of the power engine, change of the crank angle, insulation, modification of number of revolutions, reinforcement of the shaken building and compensating devices. These devices can be employed anywhere and consist of creating mass forces by the aid of a device connected with the engine which forces are of equal size but opposite to the mass-forces issuing from the engine.

Plate Glass Works

The South Manchuria Railway Company will undertake the manufacture of plate glass and has ordered the necessary machines from America. Work will be started in March next year. Cut glass is already being manufactured in big quantities for export, and has a good demand at foreign markets. The success of the new venture is being watched with great interest.

The King River Irrigation Scheme for the Wei-Peh Plain of Shensi

By Laurence Impey

THE Wei-Peh plain is situated to the north of the city of Sian-fu, the capital of the province of Shensi, and is bounded on its south and east by the Wei and the Yellow Rivers respectively, having a length of more than three hundred *li* and a breadth of eighty *li*.

Baron Ferdinand von Richthofen, the well-known geologist, tells us that this plateau is formed by lake deposition, and that its bed, which once contained salt water, has been gradually filled up by the loess and other materials which have drifted thither before the wind.

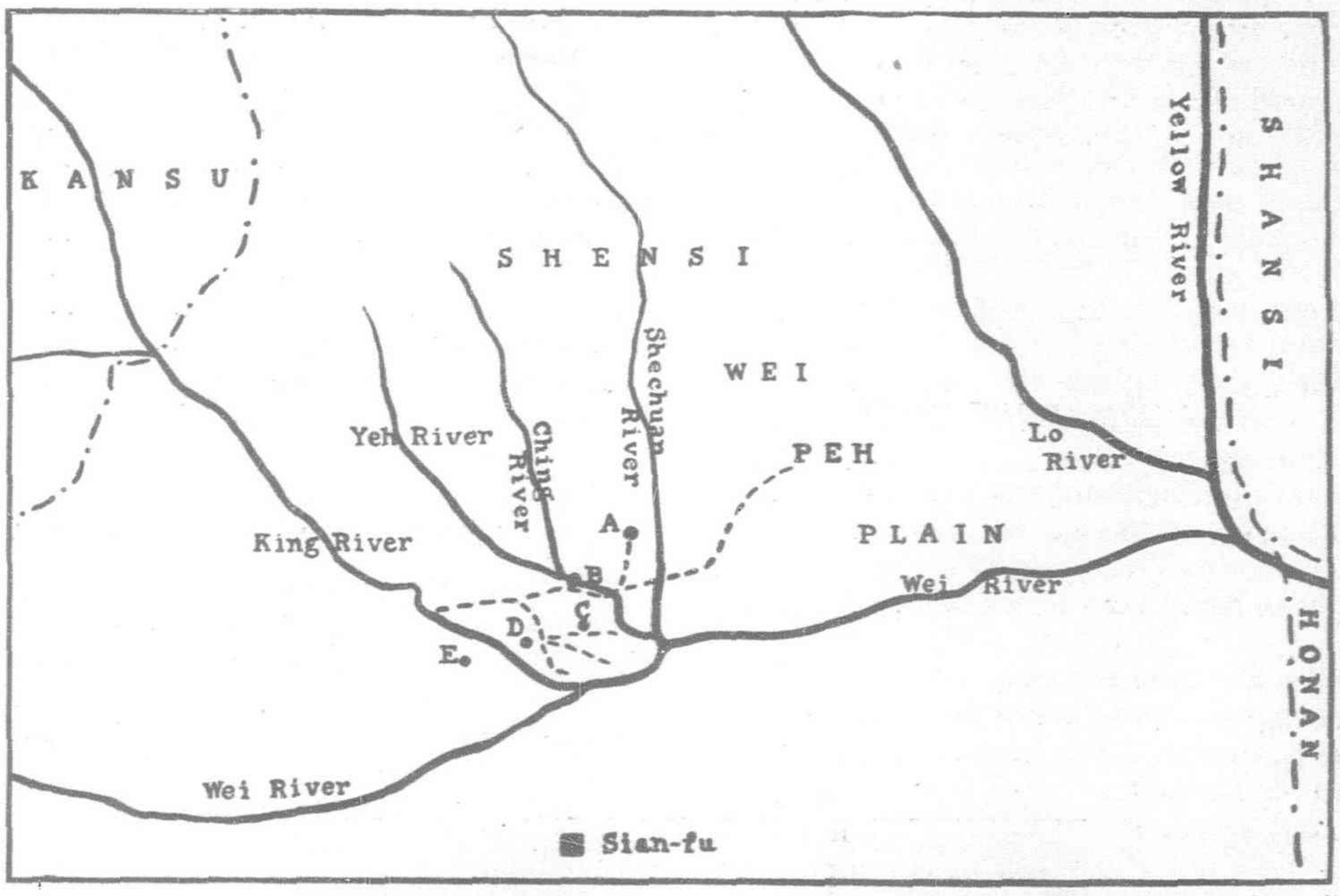
This theory is substantiated by the fact that there is still existing in this plain a small area which is covered with salty soil, while wells dug therein yield saline water of practically no value for either agriculture or for human consumption.

Irrigation, therefore, is of the utmost importance, and this becomes the more evident when it is realized that this Wei-Peh plain produces more wheat and cotton than any other districts in the whole province, and not only supplies the area around Sian-fu but also sends large quantities of foodstuffs into the neighboring provinces of Honan and Shansi.

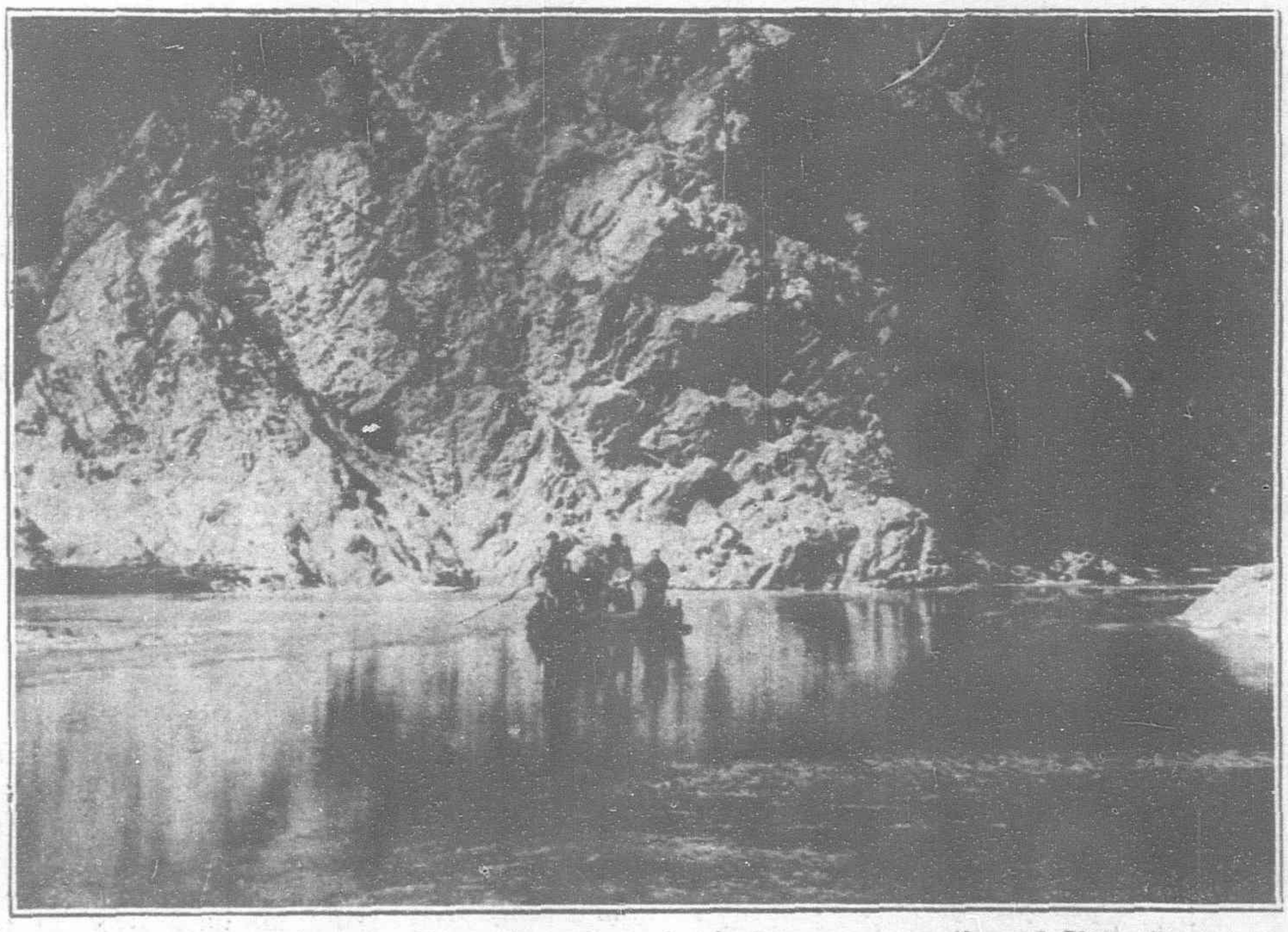
The sub-soil water supply being of this saline nature it is obvious that great importance attaches to the rainfall in those places where there is no regular scheme of irrigation from the rivers, and history shows us that unfortunately there is a drought on an average once in five years and a serious drought once in twelve years.

Chinese records tabulate 162 famines in the province since the time of the Shang dynasty (1390 B.C.), of which eighty per cent. were due to drought, and the remaining twenty per cent. to locusts or floods; but the periodicity has shortened since the time of the Ming dynasty (1363 A.D.) until now there is a famine once in ten years.

This shortage of rainfall being recurrent, the Chinese have since the earliest times endeavored to make use of the five minor rivers which traverse the Wei-Peh plain and eventually flow into the Wei river above Sian-fu, these being the Lo, the Shechuan, the Ching, the Yeh, and the King Rivers, named in sequence from east to west.



SKETCH MAP OF SHENSI. The Wei-Peh Plain Irrigation.
A. Fu Ping Hsien: B. San Yuan Hsien: C. Kao Liang Hsien: D. King Yang Hsien: E. Li Chung Hsien: ----- Old Cheng-Kuo Canal System



A survey party on the King River just above the entrance to the old Cheng Kuo Canal at "E." They are breaking their way through the ice as they make the depth measurements.

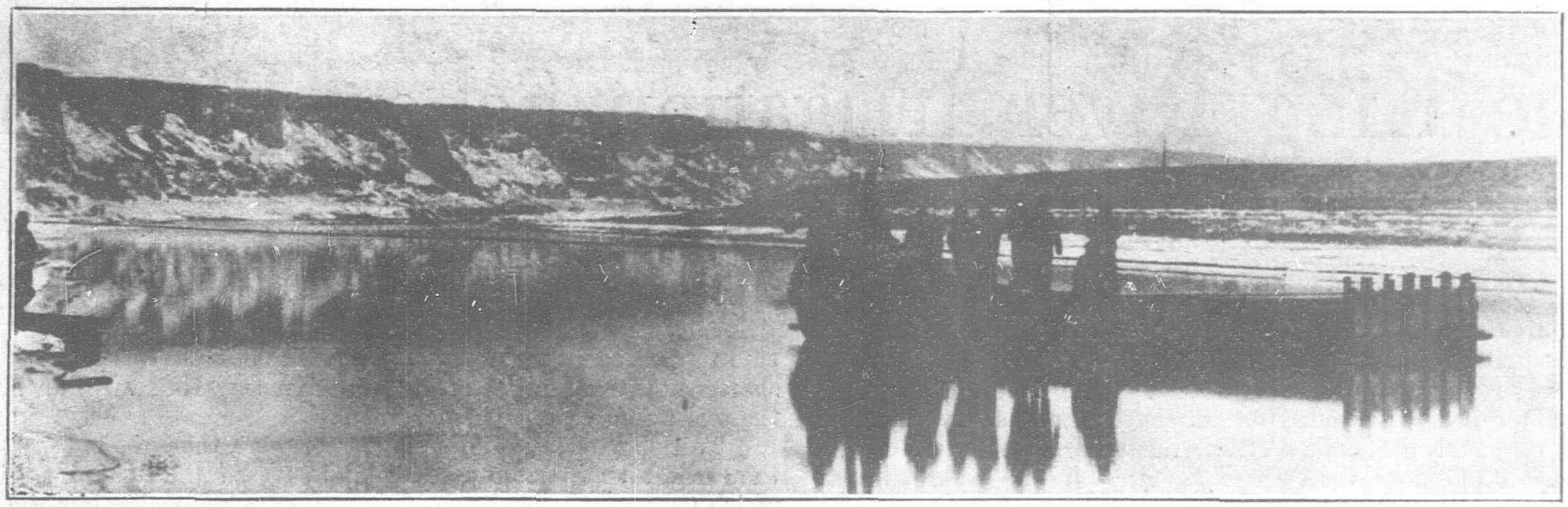
Three of them have been and still are used for irrigation purposes to a certain extent, the attempts to establish conservancy works on the Lo River during the Han dynasty proving a failure owing to the configuration of the terrain; but in actual practice only the King River out of the three has been of any great service in this direction.

The ancient history of this scheme is of considerable interest, and it may not be out of place to relate it briefly as follows:

"In the time of the seven powers, and when the rulers of these seven states were struggling for supremacy (B.C. 276), it so happened that the king of Han was greatly alarmed by the growth of the power of the king of Chin, and was desirous of undermining it by all means in his possession."

"So he called to him a skilful engineer named Cheng-kuo and sent him on a mission to the king of Chin, proposing that he should undertake certain irrigation schemes on the King River and eleswhere, thereby hoping to greatly deplete the exchequer of the kingdom of Chin and thus render it incapable of entering on a war for many years."

"It is uncertain whether the king of Chin fell into the trap or whether he saw his way out on the far side, but at any rate he accepted the proposal,



Another party carrying out discharge measurements on the King River at Pei Tun Li "L" at near its junction with the Wei River above Sianfu. The ice has melted, but the banks are still frost bound.

and Cheng-kuo undertook the canal from the King River, which centuries after was to bear his name as a memorial, and serve to remind us that he was the premier irrigation engineer of China."

"The original construction work comprised a dam across the King River built of baskets filled with stones measuring 1,000 feet in breadth and with a height of over 100 feet, and the Cheng-kuo Canal itself, which crossed the Yeh, Ching and Shechuan Rivers and irrigated nearly 700,000 acres of land."

"This scheme, far from effecting the desires of the king of Han, was an unqualified success, and for a period ot nearly one hundred years served to greatly enrich and strengthen the kingdom of Chin, which eventually became so powerful as to absorb all the other six states and found the Chin dynasty."

Unfortunately, this period of enlightenment was not destined to last, and when the dam broke about 150 B.C. the repair work was so inefficient that only 80,000 acres were watered by the new Pekung Canal, as it was called, the area being that which lies to the south of the Ching river only.

The Pekung Canal lasted some thousand years or more, and the subsequent repairs and alterations have followed the same plan as was originally outlined therein, though it has been found necessary to shift the dam higher up the stream from time to time as the old channel silted up.

As the sides of the valley of the King River are precipitous this alteration necessitated cutting further into the cliff, which consists largely of shales, conglomerates, and breccias, a geological fact which explains the constant slipping of the canal banks and the ensuing destruction of the works.

A number of springs were also tapped at one time or another and now that the former dam has once more been destroyed the people of the vicinity have neglected to rebuild it, relying on this flow from the springs very largely, so that at the present time only about 6,000 acres are supplied with proper irrigation by the canal.

Conditions on the King River

The King River has its source in the province of Kansu, and flows through mountainous country for the greater part of its course of 250 miles, until it joins the Wei River above Sian-fu, some 40 miles below the commencement of the Cheng-kuo Canal.

The banks of the river are precipitous in many places, while the bed is very uneven and composed of rocks and boulders with occasional patches of gravel or clay; the rock formation being limestone or shale to a large extent. The following statistics have been obtained by various survey parties working from time to time :—

Mean width of river	75 feet
Mean depth of river	6 feet
Mean cross section	450 square feet
Mean velocity by floating test	4 feet per second
Weight oi water at 60 F.	65-lb. per cubic foot
Velocity of flood water	19.28 feet per second
Drainage area of river	42,000 square kilometres
Grade of river bed (approximately) ..	1 in 500

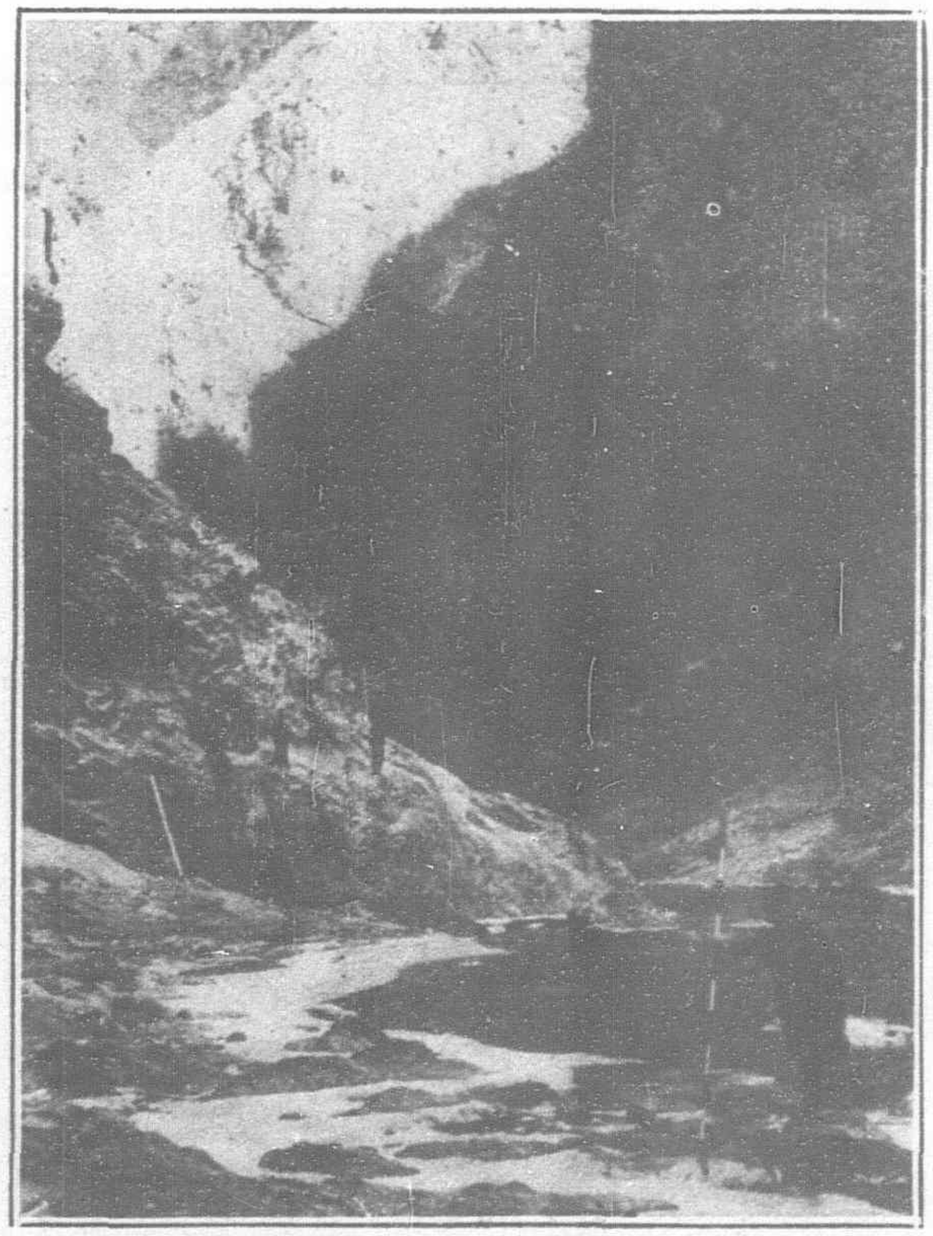
Mean discharge of King River in cu. m./sec.

1922					1923			
Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
27.4	15.5	17.0	16.0	36.9	33.1	24.1	13.8	500.0

(All measurements taken at Pei Tun station.)

These figures can be compared with the records of rainfall taken in m.m. at Sian-fu during 1923 :—

Jan.	Feb.	Mar.	Apr.	May	June	July
5.6	5.5	9.0	60.5	44.0	70.0	105.0



At the other end of the proposed tunnel at "G," where the reservoir will be constructed. The transit and surveyor are perched on the cliff at a point only to be rescued by means of a ladder or a rope.

The Course of the Old Canal System

The main canal leaves the King river at Tiao-er-tsui and runs through rock for a distance of 3.5 kilometres to the Ya-ho bridge, thence through clay cutting for 4 kilometres to Ma-tao bridge, the greater part of this being unusable for irrigation purposes on account of the precipitous terrain.

The first lateral from the canal is at Wong Yi Tao, running nearly parallel with the course of the King River, while the main canal proceeds north-east for about 10 kilometres to Shen Chiao Chen, and thence for seven kilometres more to the village of Liu Hai.

Turning eastward through Han Ti Chen the canal divides into three branches at San Pei Tzu, having covered a total distance of 28 kilometres in all.

The southern branch supplies the city of King Yang Hsien, having a length of 10 kilometres, while the middle branch runs 10 kilometres to Peng Chen Cha in the district of Kao Ling Hsien.

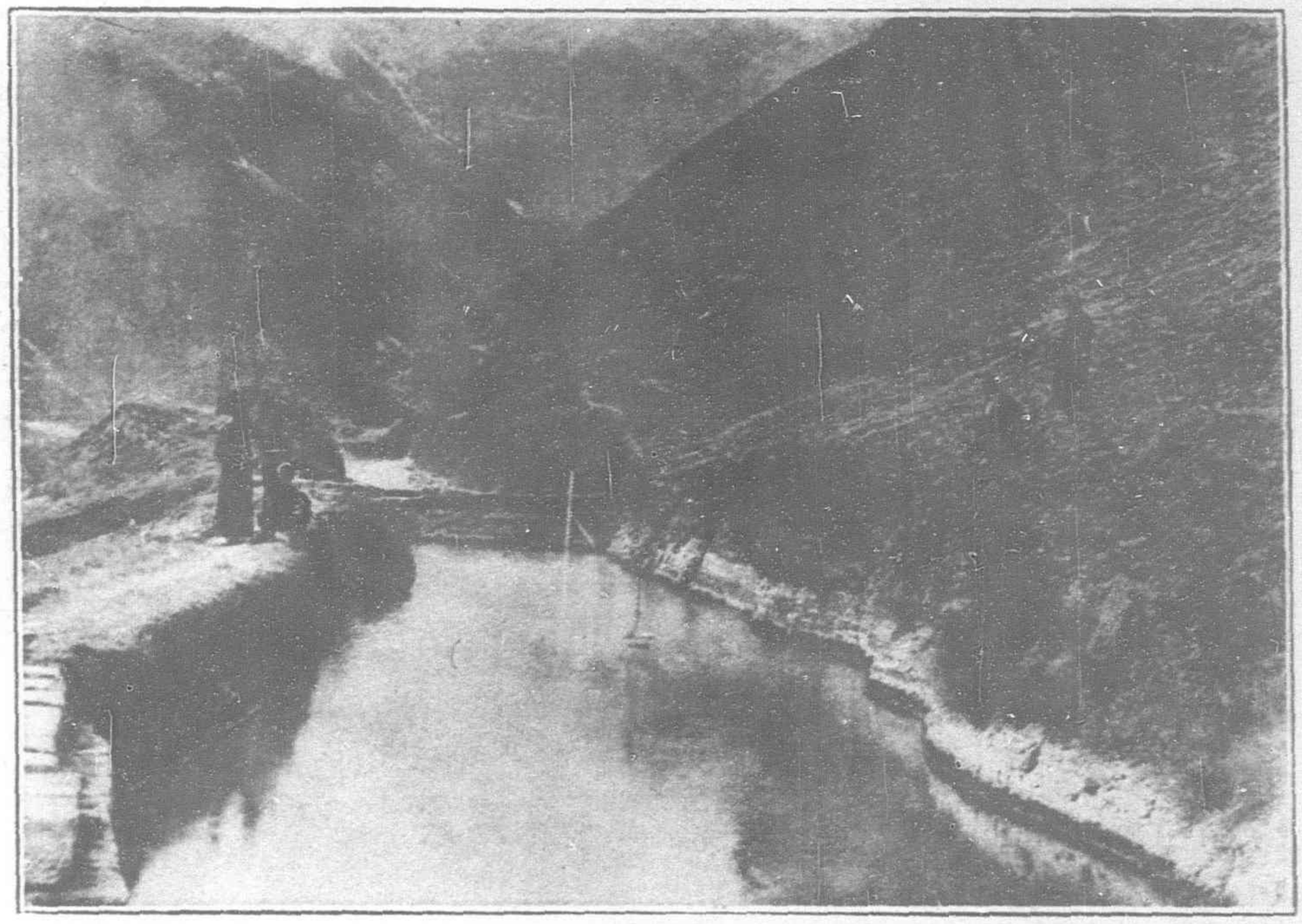
The northern branch runs through the city of San Yuan, beyond which it only proceeds for another 10 kilometres, so that it is estimated that the total length of the canal system with its branches and sub-branches only amounts to 180 kilometres in all.

The following figures indicate the possibilities for irrigation if a proper scheme can be put through, and enable one to realize what a vast undertaking it is to attempt to arrive at a position equal to that attained by the famous Chinese engineer Cheng-kuo :—

District	Irrigable Land	Now Irrigable	To be Irrigable
King Yang	46,000 acres	4,300 acres	41,700 acrse
Li Chuan	600 ,,	200 ,,	400 ,,
San Yuan	30,000 ,,	600 ,,	29,400 ,,
Kao Ling	24,000 ,,	400 ,,	23,600 ,,
Ling Tung	1,000 ,,	100 ,,	900 ,,
	101,600 acres	5,600 acres	96,000 acres

Even when the irrigable area covered by this proposed system is supplied, it will only be one-seventh of the area which was served by the canal built by Cheng-kuo, and but slightly greater than that watered by the Pekung canal of 150 B.C.

Of course there is no reason, topographically speaking, why irrigation should be confined to the above measured area, for a satisfactory scheme of dams, reservoirs, and canals should enable the engineer to supply almost the whole of the districts which were originally supplied by the Cheng-kuo canal, for the costs of extensions will be more than covered by the added value of the land and crops.



Taking dicharge measurements on the Lung Tung Canal at Er Lung Wang Miao station at "F." Note the precipitous hillside which threatens the safety of the canal by possible landslides in frosty weather.

It may not be out of place to append here a schedule of crops grown in the area under consideration, together with an estimate of water supply necessary as fixed by the farmers and the irrigation engineers.

The farmers tabulate their rainfalls roughly under three headings :

1. One spade deep of rain, corresponding roughly to 10-20 millimetres.
2. One plough deep of rain, or roughly 20-30 millimetres.
3. One penetrating rain, or from 40-50 millimetres.

and they state that one penetrating rain is necessary before planting crops, with one plough deep of rain per month during the winter months and three times that amount during the summer months.

A closer observation of the various crops was also made and the results were as follows :

Crops	Seeding	Harvest	Growing Period	Water requirements
Millet	3rd moon	8th moon	150 days	5 mow-feet
Green bean ..	3rd ,,	8th ,,	150 ,,	8 ,,
Rice	4th ,,	8th ,,	150 ,,	3 mow-inches daily
Canary seed ..	5th ,,	8th ,,	100 ,,	7 mow-feet
Yellow bean ..	4th ,,	9th ,,	140 ,,	7 ,,
Pearl Barley ..	5th ,,	8th ,,	100 ,,	8 ,,
Buckwheat ..	6th ,,	9th ,,	90 ,,	5 ,,
Barley	8th ,,	4th ,,	250 ,,	5 ,,
Rye	8th ,,	5th ,,	260 ,,	5 ,,
Cotton	3rd ,,	9th ,,	190 ,,	8 ,,
Tall Indigo ..	8th ,,	5th ,,	250 ,,	5 ,,
Small Indigo ..	4th ,,	6th ,,	90 ,,	15 ,,
Vegetable Seed ..	6th ,,	4th ,,	300 ,,	5 ,,
Garlic	7th ,,	5th ,,	300 ,,	16 ,,
Garden Pea ..	9th	5th ,,	230 ,,	5 ,,

(*Note.*—1 mow-foot × 1 mow of land covered by 1 foot of water.)

If we now turn our consideration to the average cost and yield of the foregoing crops in a good season we find :—

Crops	Yield Tou per Mow	Cost per unit in $	Income per Mow in $
Millet	10	0.45	4.50
Green bean ..	6	0.50	3.00
Rice	20	1.20	24.00
Canary seed ..	6	0.60	3.60
Yellow bean ..	5	0.45	2.25
Pearl barley ..	7	0.60	4.20
Buckwheat ..	5	0.50	2.50
Barley	10	0.45	4.50
Rye	7	0.70	4.90
Cotton	40 catties	0.20	8.00
Tall indigo ..	155 ,,	0.15	23.25
Small indigo ..	200 ,,	0.20	40.00
Vegetable seed .	5 tou	0.70	3.50
Garden pea ..	4 ,,	0.50	2.00
Garlic	22,000 bulbs	0.20 per hundred	44.00

(*Note.*—One tou × 10.35 litres, and one catty × 1-lb.)

The figures in both the foregoing tables are from reports submitted by a Chinese engineer who accompanied a survey party through the whole area concerned, and though expert tests carried out over a considerable period of time might lead to slight alterations, they are nevertheless of great interest as being one of the first estimate of this nature prepared in China.

Having thus reviewed the most important factors in the past history of the King River irrigation, and briefly considered the agricultural necessities and possibilities in the area concerned, we must now turn our attention to the terrain as indicated in the accompanying maps and endeavor to decide on the form of scheme which is likely to be most effective, and, other things being equal, least expensive.

The first plan put forward by the engineering party responsible for the inspection of the site covered the restoration of the old canal together with improvements and extensions of the existing system, and the Chinese submitted an estimate of expense as follows :—

Work	Length	Material	Cost per Lin.ft.	Total
Canal retaining wall ..	6,000 ft.	Concrete	$ 70.00	$420,000.00
Outlets, four		Cement	800.00	3,200.00
River dam	300 ,,	Concrete	150.00	45,000.00
Lock for canal ..	30 ,,	Stone	150.00	4,500.00
Cleaning pits, four ..		Concrete		18,000.00
Rock excavation ..	4,000 ,,		10.00	40,000.00
Canal bed	6,000 ,,	Concrete	8.00	48,000.00
Equipment, engineering				50,000.00
Organization expenses	(six months)			10,000.00
				$628,700.00

This expenditure only covers the work to be done in restoring the old canal at point E-F, the estimate for time needed being rather too short in the opinion of writer, as the nature of the rock may lead to landslides and unexpected obstacles, while transportation of necessary materials to the site takes time and money also.

To this the Chinese engineer appends the following extensions and improvements:—

Work	Length	Material	Cost per Lin. ft.	Total
Improving canals	360,000 ft.	Earthwork	11 cts.	$ 39,600
New canals ...	180,000 ,,	,,	57 ,,	102,600
Double span stone bridges, thirty			$1,200	36,000
Canal locks, six...			3,000	18,000
			Total	$196,200

making a total of over $820,000 in all, without any allowance for the purchase of the necessary land from the owners, or the organization expenses for the time required, which cannot be much less than one year.

In any case the project is not one than appeals to the conservancy engineer, for it provides no remedy for the troubles which ruined the canals before, and which would doubtless do so again in a few years, so that the expenditure would be practically wasted.

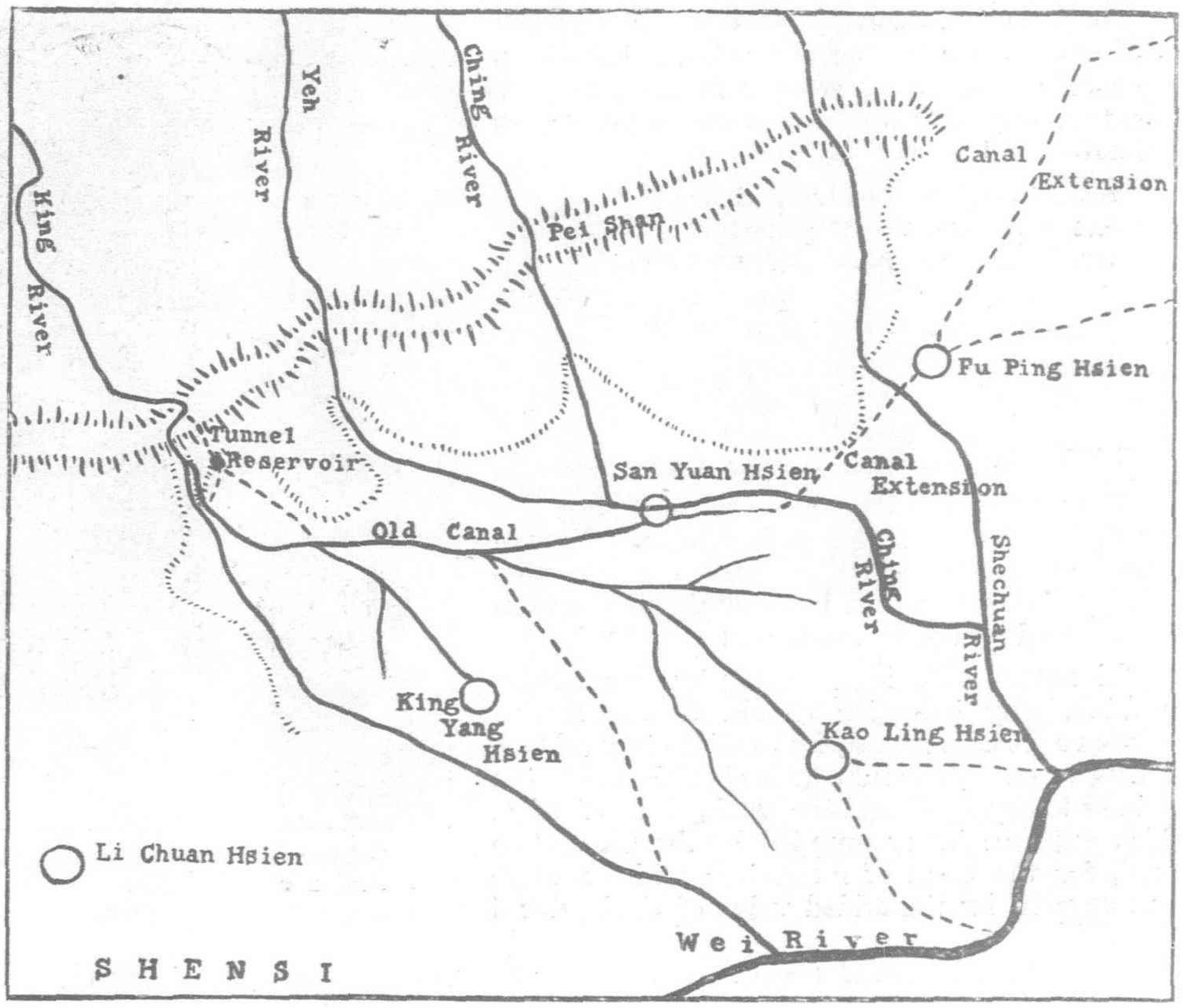
The second scheme was also reported on by a Chinese engineer, but is much more exhaustive in its nature, and indicates the possibility of constructing an irrigation works which shall be of a lasting character, though at a somewhat greater first cost.

The proposal put forward can best be understood by reference to the accompanying maps, which indicate roughly the terrain and the locality of the present works.

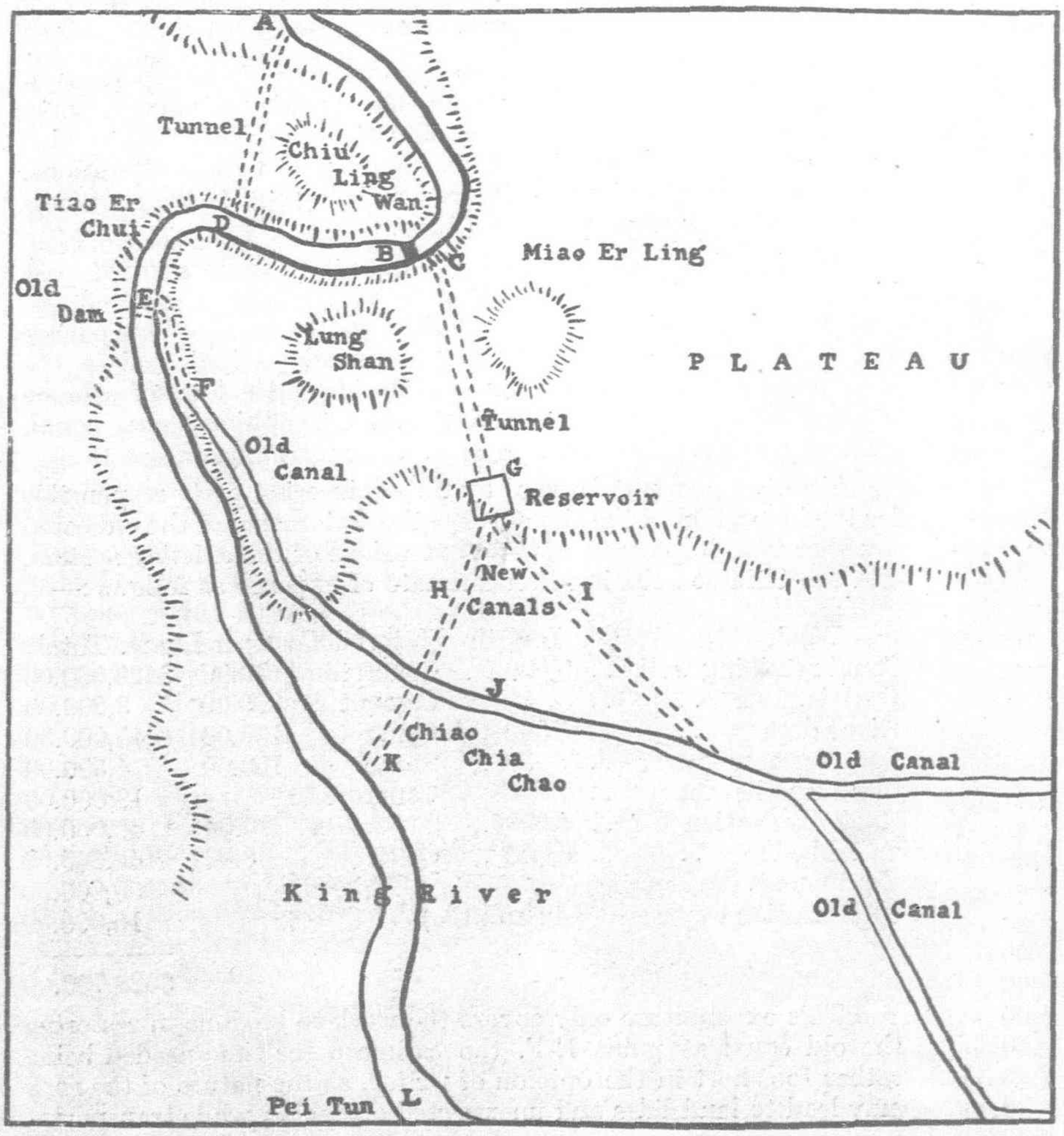
In the first place it is intended to cut a culvert tunnel through the hills at A-D, in order to divert the course of the river from the working site at B.

At C-G an irrigation tunnel will be built, leading to a reservoir at G, and thence branch canals will lead the water by H and I into the King River and the old canal system as required.

A low dam at B will divert the flow of the King River into the irrigation tunnel when completed, by the simple expedient of closing the culvert tunnel at A, and it is proposed to follow up the construction of the low dam by another high dam below it when funds will permit.



The King River Irrigation Scheme.



King River Irrigation Scheme.

The culvert tunnel is all rock work and has a length of 400 metres, with a cross sectional area of 12 sq. metres and a discharge of 60 cum/sec, while the irrigation tunnel has a total length of 2,560 metres, 1,500 metres of which is in rock and the remainder in loess.

The tunnel will be lined with cement, and two shafts will be provided, together with the necessary vertical sluice gates at the entrance and outlet.

The low dam will have a height of 13 metres and a length of 160 metres at the widest, being constructed n stone and cement on a rock foundation.

The high dam to be subsequently built below the low dam will be of cyclopean concrete on a rock base (white oolitic limestone) and will have a height of 75 metres and a length of 400 metres, giving a reservoir capacity of more than eighty million cubic metres.

The estimated water supply from the King River amounts to 788,400,000 cubic metres, and with an estimated efficiency of 60 per cent., there is a total of 473,000,000 cubic metres that can actually be used for irrigation.

The outside reservoir will be 60 metres in width and 275 metres in length, closed by a stone dam with a penstock opening at the lower end, the depth being 42 metres.

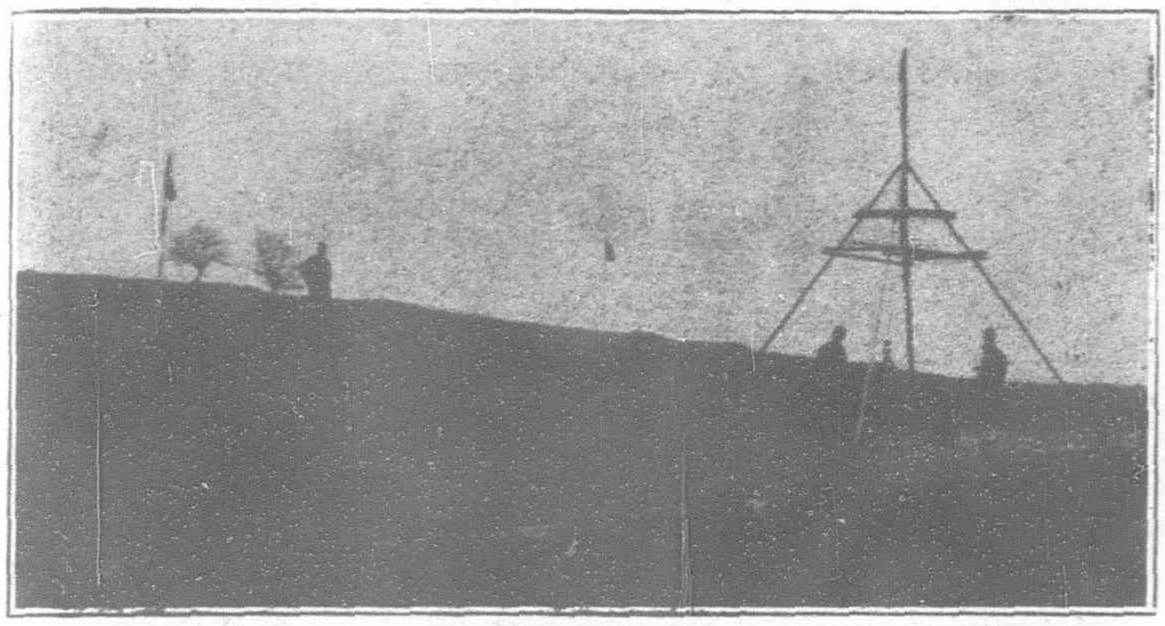
The outlets will permit either of a direct supply to the new main canal, or an overflow into the King River again, the capacity of the main canal being estimated at a minimum of 25 cubic metres per second.

The route taken will be that of the old Cheng-Kuo canal to a certain extent, but extensions of the present disused system will carry the water across the Shechuan River to Fu Ping Hsien, irrigating the area beyond there until it eventually reaches the Lo River above Lung-yong, where it will discharge.

The existing canal system suffers greatly from loss by seepage, the measured leakage being about 30 per cent. of the total volume, so that it is necessary to carry out extensive repair work on the canal bed before efficiency can be guaranteed.

As before mentioned, the area that could be covered by the existing system if it were put in good shape would be a little over one hundred thousand acres, but the scheme as outlined above would greatly increase this when completed, the figures being estimated as follows :

King Yang and Li Chuan Hsiens	.. ..	103,000 acres
San Yuan and Fu Ping Hsiens	.. ..	131,000 ,,
Lin Tung, Wei Nan, and Pu Cheng Hsiens (lying to the east of the Shechuan River and being new construction work)	..	390,000 ,,
Total	.. ..	624,000 acres



The survey party carrying out base line measurements close to the main triangulation station above the King River.

It will be seen that this comprises nearly the total area covered by the canal scheme constructed by Cheng-Kuo ; at a cost which is yet unknown, but which could be spread over a number of years and repaid out of the receipts on taxation on the improved land.

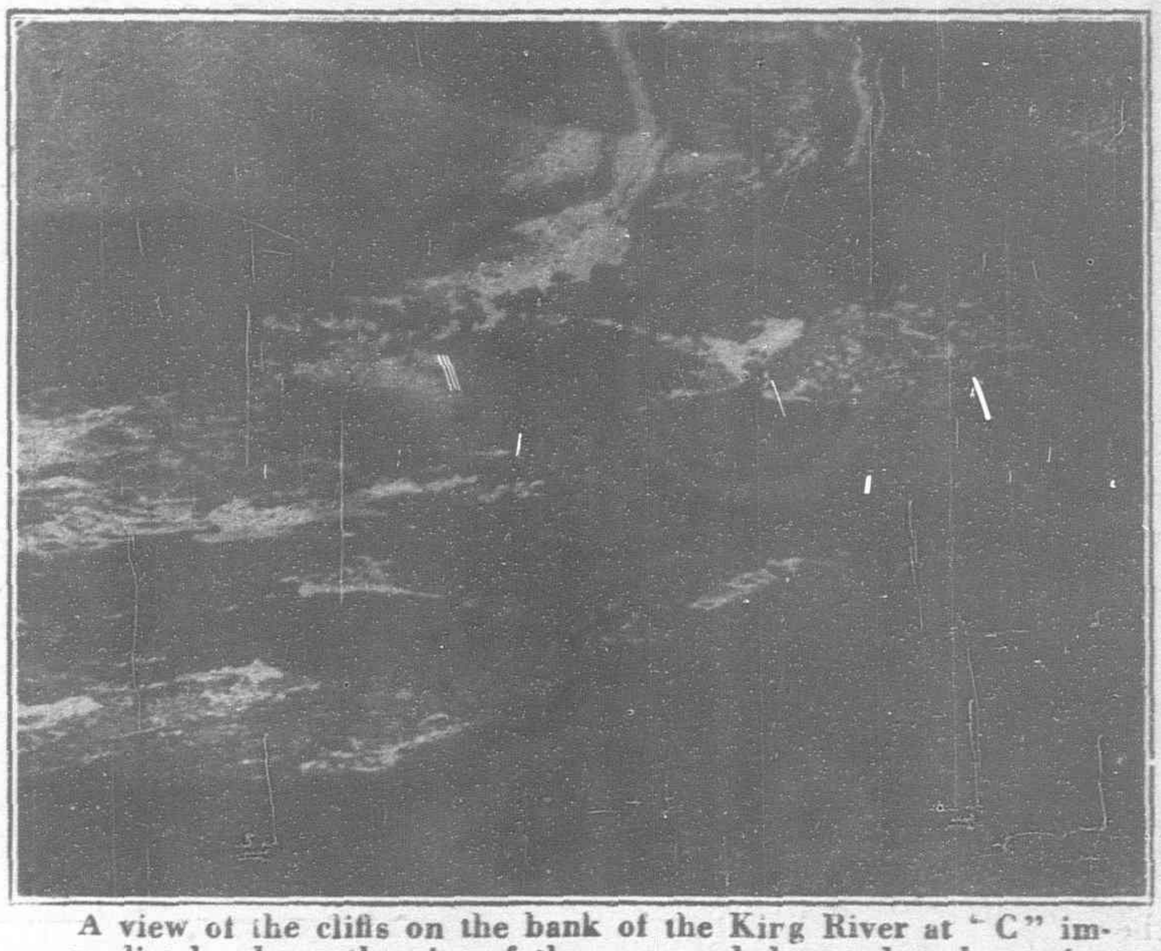
The following figures have been submitted as the initial expenses for the preliminary work :—

Work	Area	Cost	Total Cost
Rock excavation, irrigation tunnel	24,750 c.m.	$ 1.70 per c.m.	$ 42,075
Loess excavation, do. ..	17,490 c.m.	0.55 per c.m.	9,620
Timbering			5,170
Shafts, one in rock ..	56 m.		
one in earth ..	100 m.		3,000
Cost of lining		25.60 per c.m.	179,200
9,000 labour days for hauling materials			4,500
Compressed air and ventilation costs			100,000
Plant, including pumps, cranes, drills, etc. ..			100,000
Light rails, forty tons at $120 to the ton ..			4,800
Cost of car			4,000
Superintendence charges ..			55,000
		Total	$507,365

This figure would seem to be fairly accurate if one may judge by similar work which the writer has examined elsewhere, though it must be admitted that the work in the other case was carried out in civilized countries where supplies were easily obtainable as required, and transportation presented no great difficulties.

Continuing the estimate we find that :—

Work	Area	Cost	Total Cost
Culvert tunnel at A-D.	400 metres	$ 200 per m.	$ 80,000
Low dam	7,000 cu. m.	20.30 per c.m.	142,100
Excavation of new canal	184,500 c.m.	0.30 per c.m.	55,350
Masonry facing, canal..	1,300 c.m.	21.50 per c.m.	27,950
Enlarging old system ..	120 k.m.	500 per k.m.	60,000
Prolonging old system	60 k m.	1,250 per k.m.	75,000
Purchase of ground sites	250 acres	120 per acre	30,000
Superintendence charges			10,000
Three Sluice Gates ..		5,000 each	15,000
Bridge reconstructions			2,000
		Total ..	$497,400



A view of the cliffs on the bank of the King River at "C" immediately above the site of the proposed dam and at the point where the irrigation tunnel will commence.

To this may be added at least one million dollars for the construction of the high dam when required, if one takes similar construction costs as a fair estimating basis, so that the scheme will need slightly over $2,000,000 Mex. in all.

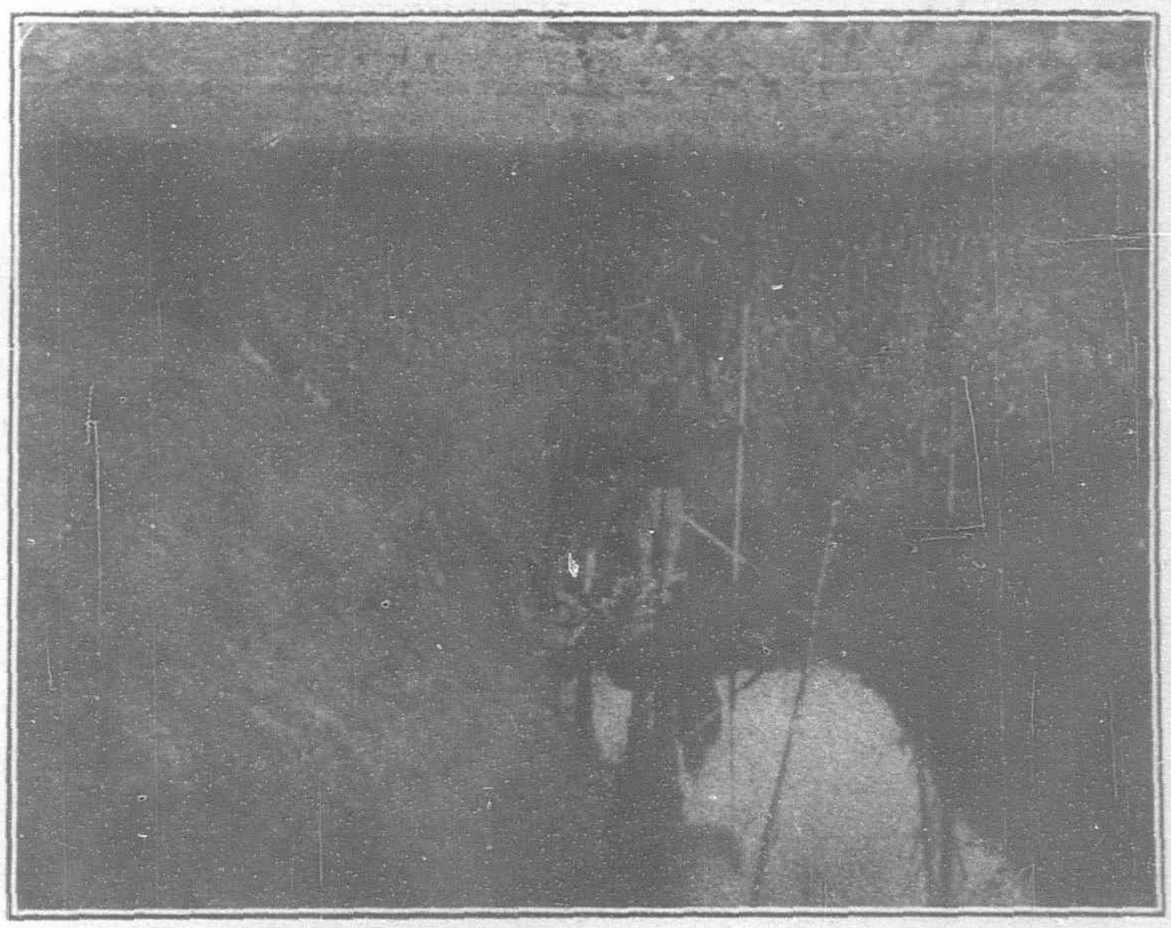
This is the whole project as presented to the public by the governor of Shensi, who is very desirous of seeing the work commenced as soon as possible ; and he has applied to the executive committee of the China international famine relief commission for assistance in carrying it out.

The principle recently adopted by the commission has been to provide funds for famine prevention schemes on a loan basis, and it is probable that they may consider the feasibility of this scheme under these conditions, providing that satisfactory guarantees can be provided by the provincial authorities.

The surety of the Chinese chambers of commerce is the best security obtainable, and it is the experience of the writer that they are generally willing to support such schemes for the public welfare, providing that they are assured that the funds will be handled by foreign committees, thus avoiding any danger of the military confiscating it for their own purposes.

It would only be necessary to expend about one million dollars for the commencement of the work, leaving the construction of the high dam for a later date, when it is seen how work is progressing and whether the authorities are giving full support to the scheme.

As to repayment, this could be spread over three to five years, and would be largely obtained by taxation on the land benefited, for the increased yield in crops would easily enable the proprietors to carry the extra charges after the first two years receipts.



An engineering party on the Lung Tung and Cheng-Kuo Canal, part of the King River Irrigation Scheme, Shensi. The coolie holding the pole for a profile survey is using small boats known as "Dragon's Shoes."

Mining in the F.M.S.

From an Account of the Geology and Mining Industries of South Selangor and Negri Sembilan

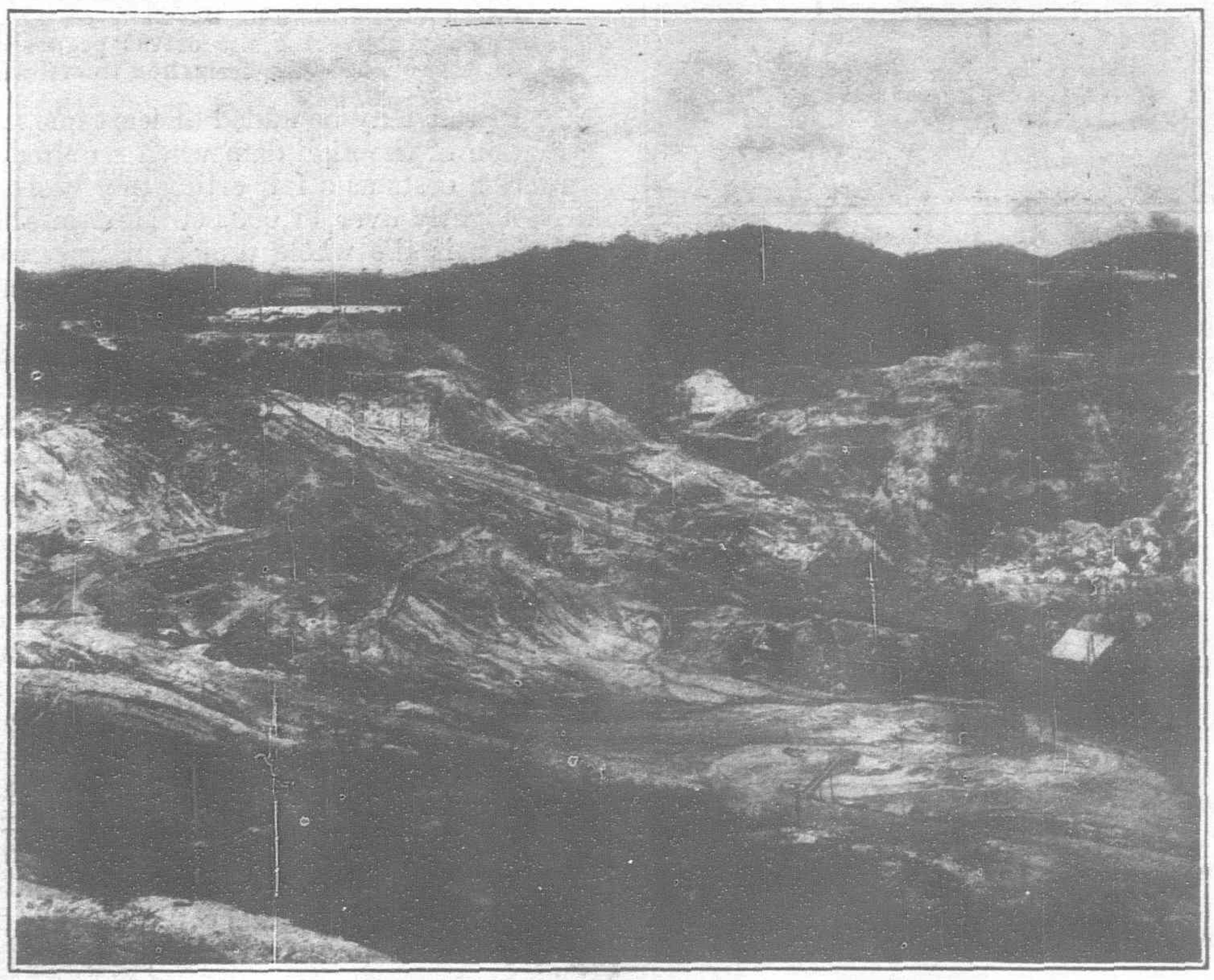
By E. S. Willbourn, Asst. Geologist, F.M.S.

KUALA LUMPUR PLAIN.—In the neighborhood of Kepong the granite hills near the contact with limestone have been hydraulicised to a considerable extent; and, in the same district, the alluvium is being worked by open-cast methods down to the bed-rock of dolomitised limestone. Several exposures in French Kepong Mine and in Chinese-owned mines in the neighborhood show the general line of the granite limestone contact, and prospecting is being carried on in the search for further rich alluvial deposits. Yap Po's mine is situated on the contact, and it seems that a fissure has been formed in the limestone, where it came into contact with the granite, which now contains tin-bearing sands and clays. The *karang* here contains a comparatively small proportion of clay. The old French Kepong Mine was on the contact too, and it contained a rich *lead* of tin. This was probably an alluvial deposit laid down in a fissure formed by solution at the granite, limestone contact. The mine which is at present being worked by the French Kepong Company has bed-rock of limestone (Plate IV. Fig. 2) and the granite contact is several hundred yards away.

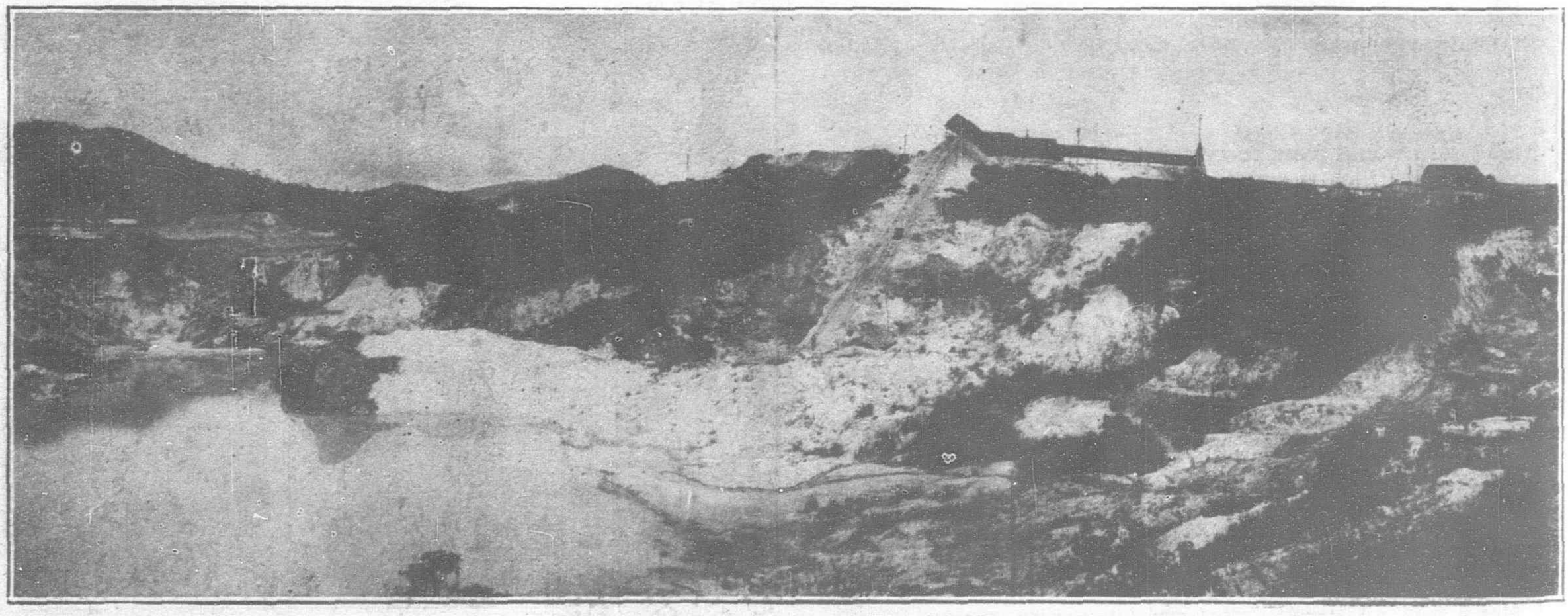
The granite hills near the 8th mile Rawang road are being ground-sluiced, but not much work is now going on there, and there is also an old *lampan* at the second mile from Kuala Lumpur, on the Batu road, which has evidently not been worked for some years. The face shows weathered fine-grained granite, which is a small intrusion into the country rock of shales and sandstones, and which may be continued eastwards into the limestone.

There are several open-cast mines in the alluvium near Setapak, most of the country between here and the granite to the east and to the Ampang road being formerly mined for tin, and at the present time there are *lampan* workings in the weathered schists just to the east of the rifle-range.

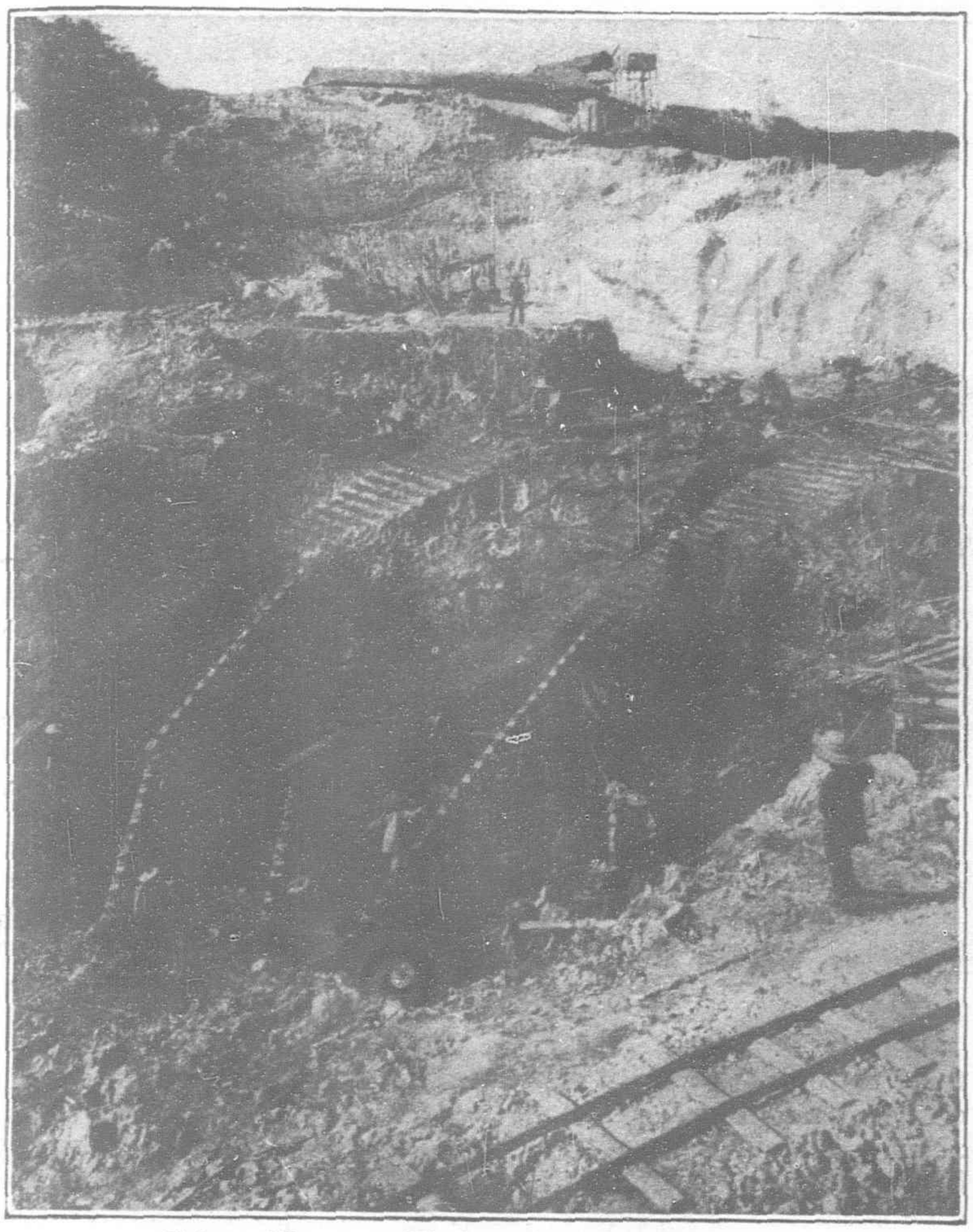
There are some very large open-cast mines in the neighborhood of Ampang, all with dolomite and dolomitic limestone as bed-rock; the proximity of the main range granite is indicated by the occurrence of intrusions of pegmatite and also of fine-grained aplites. In the mine to the southeast of Ampang, nearest the granite hills, such intrusions are connected with the presence of scheelite, of which it is said that three hundred pikuls were won from the neighborhood of a pegmatite-vein. Some lumps of quartz were noticed lying on the floor of this mine with crystals of cassiterite several inches across, so it is clear that the tin here must be derived from veins in the neighboring granite and schist near the contact, for these large lumps cannot have traveled far.



The Sungei Besi Tin Mine, at Sungei Besi, Selangor, F.M.S.



Kepong Tin Mine at Kapong, Selangor. F.M.S.



Chinese Women at Work in the Kepong Tin Mines

Lode Mine Southeast of Ampang.—The granite in this mine is non-porphyritic and is veined with kaolin-stringers, and, in addition, it is penetrated by two sets of vertical quartz-veins, one with strike N., 30°W. by S. 30°E., and the other with a strike N., 50°E. by S., 50°W. The widest vein noticed had a breadth of eighteen inches and was deeply stained with iron. The quartz-veins are tin-bearing, and, in addition, tin was won from irregular patches of pegmatite in the granite. The mine had been abandoned when it was visited in 1920. In March 1917, pegmatite was being worked at the lowest spot in the centre of the mine-floor. It was impossible to be sure about the mode of its occurrence, but it appeared to have no relation to the above-mentioned quartz-veins. The lode-stuff from the mine is very rich in arsenopyrite, and contains a little topaz.

The granite slopes south-west of Ampang, within two miles of Pudu, and the low-lying granite country east of the railway at Salak South, were being sluiced four or five years ago, and in 1917 some lodes were being worked by shafting on them.

There are several open-cast mines north-west of Salak South, the largest, Thong Hing's and Thong Fok's mines, being in alluvial beds, with limestone and dolomite as bed-rock, both being near granite, and having granite exposures on their floors and walls. The west side of the former mine is within a few yards of hills ground made up of a formation of shales and sandstones, which are penetrated by thin kaolin-stringers and thicker veins of quartz.

The greater part of the low granite country which lies to north and west of Salak Hill has at one time been worked for tin.

Sungei Besi Valley.—In this valley, the low-lying country forms a long narrow strip of country running from north to south, flanked on the west side by hilly land formed of shales and quartzites, and on the east by granite hills. There is no doubt about the origin of the tin—many of the granite hills near the stanniferous alluvial deposits have also been stripped of their softer weathered portions by Chinese miners. Of the open-cast mines, the one known as Chai Seng's mine, east of the Salak Hill, has already been mentioned, as containing crystals of an altered mineral (probably amphibole) in the dolomite bed-rock, they were evidently introduced into it by the intrusion of the neighboring granite. The crystals have not been noticed in the Thong Onn Kongsi Mine dan in the Sungei Besi Mine in the dolomite limestone near the granite contact, perhaps because the actual contact cannot be seen, and the zone containing minerals formed by contact metamorphism in limestone rarely exceeds a few inches in thickness. In Thong Sang's mine near Serdang, which is also an open-cast, granite is seen in contact with dark-blue shales, which are like shales seen near the granite contact east of Ampang. The rocks near the contact are soft enough to be worked with a *changkal*, and contain a considerable amount of tin ore, which, of course, differs both in appearance and origin from the tin of the alluvial beds which are worked in the same excavation. Here is noticed, that there are thin quartz-veins running at right angles to the granite-shale contact in the granite, which do not penetrate into the sedimentary rock. In the Thong Sang Mine there is the difference that, in the altered shales near the contact, numerous quartz-veins lie in the foliation-planes, parallel to the contact, and this suggests that a shearing-movement has taken place in the shales along the contact-plane, and that the quartz-veins, which formerly penetrated them at right angles to the contact, have in this way been dragged sideways, and appear to have been intruded parallel to it.

As already mentioned, a muscovite rock containing a little quartz is common in this district, and thin stanniferous quartz-veins, which penetrate it in a small hill near Cheras, are being worked by Chinese miners. At the 16th mile from Kuala Lumpur just south of Kajang, there is a *lampan* in the decomposed fine, grained granite which is penetrated by thin stanniferous veins of quartz. In 1916 shafts were being sunk by Chinese into some of these veins and there was little other work going on.

The only other mine of any size in this part of South Selangor is a *lampan*, working in weathered granite and the overlying soil, on the Negri Sembilan boundary, near Broga.

Sungei Way.—The granite in this district has introduced tin-bearing veins of quartz into the sedimentary rocks, as, for example, in the quartzites and shales near Pantai, and near the 8th mile Kuchai road.

At Pantai about fifteen years ago these veins were followed into the country rock, and a battery was erected to crush the stone. In 1907, Mr. Warnford Lock wrote "Much if not most of the original deposit still remains in the hills, and several attempts have been made by Europeans to operate on it. So far, but little real benefit has resulted. On the other hand, the mode of procedure has been very ill-judged and costly, and the scale of operations has been trifling, so that past failures are no real criterion of what the future can do. Work on an extensive basis will have to embrace some scheme for disposal of tailings, as there is next to no dumping space, and no convenient river to act as a tail-race."

The sedimentary rocks near the 8th mile, Kuchai road are similar to those at Pantai, and, in the past, the hills to the south of the road were lampanned. The alluvial deposits derived by

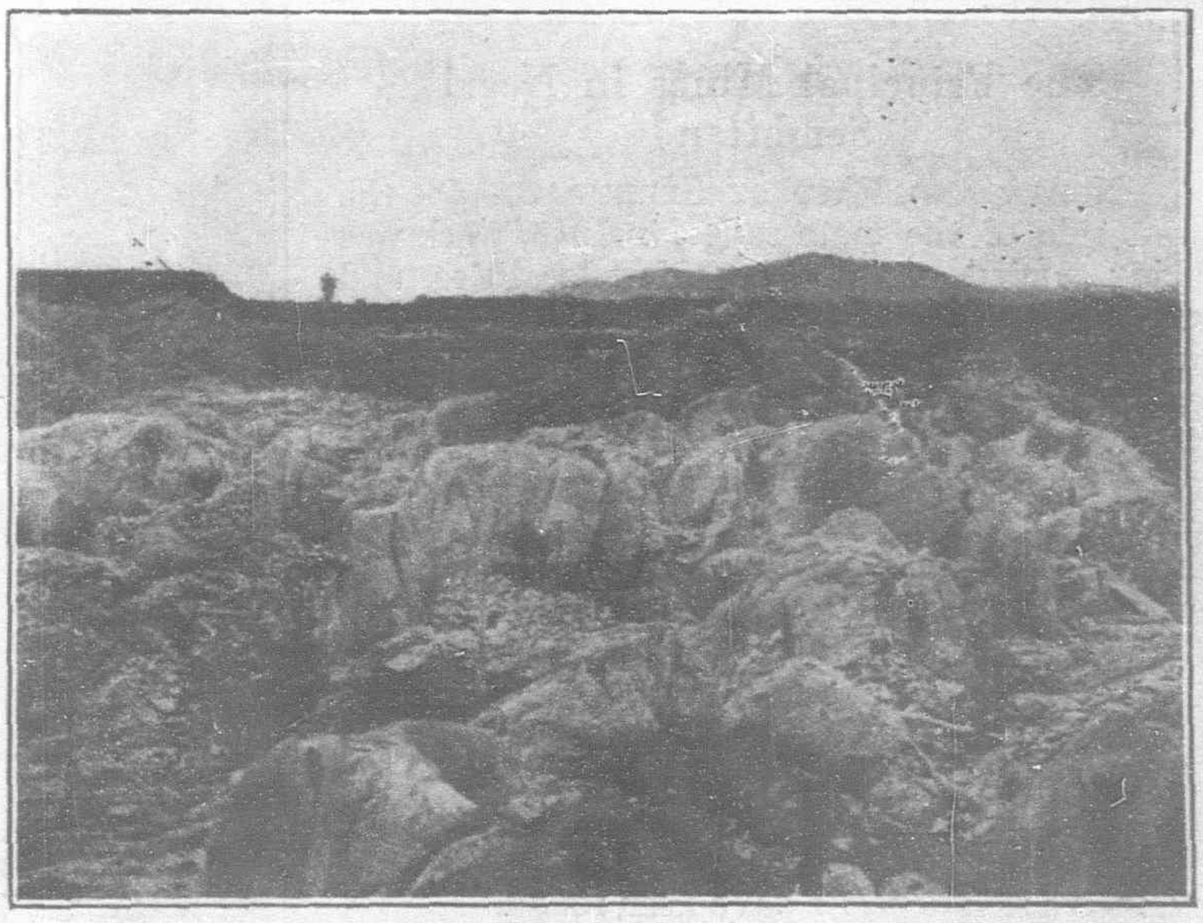


Fig. 2. Limestone showing steady dip away from granite. Granite forms hilly ground 200 yards to the right (not shown on the photograph). French Kepong Mine

Another View of the Sungei Besi Mine

erosion of these hills are being worked open-cast in a *lumbong* on the north side of the road, and veins in the decomposed quartzite which forms the bed-rock also provide some tin.

The mine in S. Way Estate was in 1920, being closed down, in order to bring it under European management, and to use more up-to-date methods. An exposure of weathered non-porphyritic granite veined with tin-bearing quartz-veins gives the source of, at any rate, part of the tin-ore, which is disseminated throughout a considerable thickness of coarse-grained wash, consisting of quartz grains embedded in a kaolin-like clay. The beds of *karang* dip at an angle of 30° away from the granite. Clay bands which are interbedded with the *karang* show slight faults and dislocations, which suggest that limestone forms the bed-rock, though, at the time of writing, this has not been definitely proved. A considerable amount of tin-ore was obtained by working the granite intrusion mentioned above. The ore in this mine contains a lot of pyrites, and galena is not uncommon. Some scheelite is said to have been obtained by washing the alluvium excavated when digging a sump-hole.

The Principal Mines in Negri Sembilan

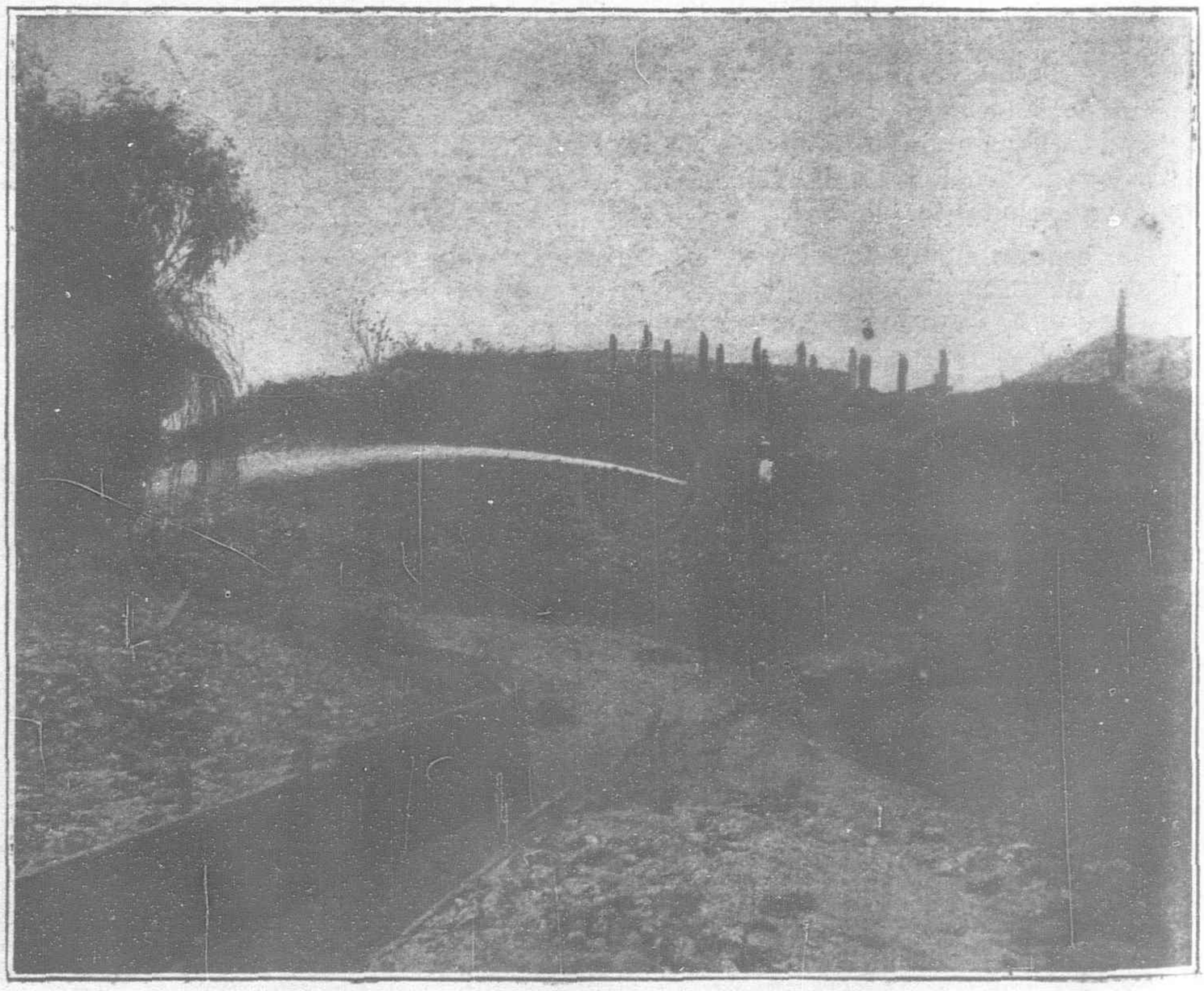
NORTH AND EAST OF SEREMBAN.—On the west side of the main range, in 1915, work was being carried on in only a few localities, and not on a very large scale. There are old alluvial workings near Pajam and Mantin, in the former case near the granite boundary, but little or no work was being done. On the Setul Pass, a few miles from Seremban, a few coolies were at work on the thin deposits of alluvium, and the tinstone here was evidently derived from the pegmratite-veins which are so plentiful in this neighborhood. Operations were on similar scale near the Labu road and railway, in the neighborhood of Seremban. On the road from Lenggeng to Broga too, the alluvium derived from the granite hills has yielded quantity of tin, but only a few coolies were working there, and no extensive rich deposits have been found.

Prospecting has been going on in several of these localities with a view to dredging.

SEREMBAN.—Several open-cast mines were being worked within a mile or two of the town in 1916. There was a Chinese-owned mine between the Setul and the Kuala Pilah roads, within a short distance of the granite-schist contact, in which peaty beds were exposed on the sides of the excavation, underlain and overlain by sandy beds. In an open-cast mine situated near the second mile railway-crossing on the road to Port Dickson, the bedrock was schist, overlain by a grey pebbly sand containing tinstone, the granite junction being one mile away to the north-west. The total thickness of the overburden in this mine was small, so it was possible to work at a profit even if the tin-bearing deposit was thin and of a low value. There were other open-cast mines near Rahang, a village on the outskirts of Seremban on the road to Tampin, and here too the bed-rock is schist, but the granite is only a few hundred yards away.

SEREMBAN TIN MINE.—All the mines hitherto described are alluvial workings, but that situated on the Kuala Pilah road, four miles from Seremban, differs in that hydraulising methods are used to extract the cassiterite from the soil and the partially decomposed granite and schist near the contact. A considerable distance along the granite-schist contact lies in land worked by this company, but the occurrence of tin-ore in workable quantities is very erratic, and when the mine was last visited, in 1914, operations were confined to following a thin quartz-vein with a monitor, the height of the working face down to the harder less decomposed rock being about six feet. The granite is veined with kaolin and quartz-tourmaline veins, and large veins of white quartz several yards wide occur at many places in the mine near the contact, but these large intrusions have always failed to contain tin-stone in workable quantities.

SOUTH OF SEREMBAN.—Mining has been carried on for some years in the alluvium of the Linggi Valley near Mambau at a distance of three or four miles from the granite outcrop, in an occasional open-cast mine, and this is the only district south of Seremban where any mining is carried on near the main range. There is a mine, however, near the 16th mile Port Dickson road, where



Hydraulic Operations in the Sungei Besi Mine

work is going on in the alluvial beds, both by shafting and in an open-cast, the tin having been derived from a small granite intrusion near here. The weathered part of the granite mass was being *lampanned* in 1914 though the work was then being carried out on a rather smaller scale than before. In 1914 about thirty or forty pikuls a month were obtained in the Parit Gila syndicate's mine.

TITI.—This mine, on the east of the main range, is the principal tin-producer of the state, and it is interesting to note that it also yields a considerable quantity of wolfram. In recent times, practically all the ore was produced by tunnelling into a hill through which passes the granite-schist contact, and following up various lodes through the partially decomposed granite. Work was often considerably hindered owing to hard core-boulders of granite being encountered.

Much tin was won from a vein of quartz which was called the Glami Lode, and in the beginning of 1917 the same lode was again encountered. In this mine most of the lodes have not been worked far into the schist as their tin-content then seems to become rapidly less, indeed in one exposure it was noticed that the quartz-veins ended abruptly at the contact, and were not continued from the granite into the schist. Some of the lodes have been worked down to a depth of over one hundred and fifty feet, and the lode-stuff contains a considerable quantity of arsenical pyrites. Ohe specimen was noticed to contain small transparent green crystals of a mineral which was probably *scorodite* (arsenate of iron).

There are two main sets of quartz-veins penetrating the granite of this hill, one set, including the main Titi Lode and several others, having direction of a strike N., 70°W. by S., 70°E., and another, which for practical purposes do not contain tin or wolfram, with a strike direction at right angles, namely N., 20°E. by S., 20°W. The latter set are later than those containing the tin. The shales and quartzites have been much altered at and near their contact with the granite, the shales being converted to tourmaline and mica-schists and the quartzites to mica-schists and to a hard dark-coloured homogeneous quartzose rock.

Operations were about to be considerably extended in 1917.

In the Jelundong Valley, only a few miles from Titi, a Chinese-owned mine, where decomposed granite near the contact is being worked by monitors, gives a yield of about one hundred pikuls a month. There are many *lampans* in the Jelundong, Tinggi, Kenoh and Kongkoi Valleys, working shallow alluvium and soil derived from the denudation of schists and granite near the contact, but, for the most part, they are in narrow valleys, not suited for the accumulation of extensive deposits, and, in the hilly country, operations are rendered more difficult by the presence of large boulders of granite and schist.

Hydraulic Mining in the French Tekka Mines

Old Gold Workings of Negri Sembilan

There are no gold mines at present worked in Negri Sembilan, but a description of the positions of the disused workings, and the little that is known about their history may be interesting.

CHINDRAS.—The mine is reached by walking two miles along the railway in a north-easterly direction from the station at Ayer Kuning south, and by then following a cart road through the jungle for about two miles over flat country formed of Raub shales. This is the formation at the mine, and the shales are traversed by a number of quartz-veins with a strike of north and south, one or two of which have been followed by tunnels into the hillside, and which were evidently the source of gold. They have been intruded along the bedding-planes of the shales, which dip to the west at an angle usually bigger than 45°.

In one drive the quartz-veins can be followed from the shales into a red-green weathered quartzose rock, which, under the microscope, appears to be a fine-grained granitic rock with larger rounded crystals of quartz and micaceous pseudomorphs after felspar. The rock contains no felspar, all of which has been replaced by mica. It is evidently a greisenised granite porphyry, coarser grained, though otherwise similar to, the dykerock exposed on the *lalang*-covered hills, north of Ayer Kuning station, which run in a direction from S., 60°W. to N., 60°E. towards Bukit Chindras and are only a mile or two away from Chindras. The rock is interesting because it is very like an altered granite-porphyry known as beresite, which is described by several writers as being penetrated by gold-bearing quartz-veins in the Ural Mountains. The Penghulu at Ayer Kuning says that, some years ago, his father got some gold from the Ayer Kuning Hills by washing the soil there, and, if this is true, it would appear to be certain that the gold was introduced at the time of intrusion of the dyke-rock. There is no evidence as to its age, and whether the rock should be

classified with the Pahang Volcanic series, or as an offshoot from the Mesozoic granite, is a matter of doubt.*

Mr. Scrivenor says, in his preliminary report on the gold mines of the F.M.S. in May 1904, "The quartz has a little country mixed with it. I am told that very favorable assays of this stone were made at Chindras, and that some ran 1 oz. to the ton. Nevertheless an unerected 15—head battery can be seen on the mine at the present day." He alludes to a pale-green rock, which was not seen *in situ*, composed of muscovite, quartz grains, iron-ores, and small prisms of rutile, and says that it is similar to that at Punjom, described in the same report. This is evidently the greisenised granite-porphyry.

BATU BERSAWAH.—It can be reached by going five or six miles down the Muar River from Kuala Jelei, or by following a jungle path which leaves the Kuala Jelei—Tampin road about 1½ miles from Kuala Jelei.

If the latter route be followed, in which case a guide is necessary, an interesting intrusion exposed in the banks of a tributary of the Muar River (S. Raia) can be examined, interesting because of the possibility that the rock may be connected with the occurrence of gold in the district. The country rock is light-blue Raub shales and the intrusion is of the minette type, being a dark-colored rock consisting of biotite, orthoclase, hornblende, abundant apatite, and a certain amount of quartz. The Raub shales and limestones exposed in the country surrounding the Batu Bersawah Mine show signs of folding, for the strike varies between N., 50°W. by S., 50°E. and N., 10°W. by S., 10°E. Some of the pebbles in the Muar River bear a resemblance to volcanic ash of the Pahang Volcanic series, but all are too much weathered for accurate determination.

At the mine itself, little can be made out, for the whole of the hill is covered with very long *lalang*, and the shaft is half filled up with fallen earth, undergrowth, and the ruins of machinery, but the rocks described and seen *in situ* by Mr. Scrivenor in 1904 can be recognized in the spoil-heaps near the shaft. Mr. Scrivenor's description of the mine in the report above referred to is as follows :—

"The lode at Batu Bersawah is worked by a shaft connecting four levels. The first of these is entered from the side of a hill, and has no definite designation. The second level is No. 1. No. 3 is 240-ft. from the top of the shaft. The lode outcrops on the surface with an approximate course of 350°. Nowhere is it of any considerable thickness where I saw it. It is composed of quartz, sulphides of iron and zinc, with a small admixture of country. The walls are distinct. The underlie is to the east."

"The country at Batu Bersawah runs with the lode. It is composed of a medium-grained rock, which effervesces with acid, with partings of shale. When at the mine I was deceived by the gray colour of the former and its behavious with acid and took it to be a peculiar type of limestone. The microscope, however, shows that it is an altered diabase, consisting of idiomorphic crystals of a plagioclase felspar, chlorite, and magnetite with a large amount of crushed material derived from the felspar, and abundant calcite veins. In the slides examined there are no crystals that can be called porphyritic."

"I am indebted to Mr. Benjamin Odgers, the manager, for the following notes :—In No. 1 north the ore taken out ran 7 dwt. to the ton; but there was no stone above the level for stopping to the south. A mixture of stone taken from No. 2 for 504-ft. and stone from No. 3 ran 14 dwt. In No. 3 there is a good body of quartz which has for the last year yielded an average of 13 dwt."

"The above figures looking promising for the mine; but, although I do not wish to appear an alarmist, it is necessary to add that the amount of ore crushed has been small and that until the mine has been further developed it will not be possible to arrive at a true estimate of its value. It is sincerely to be hoped that the percentages quoted will be maintained or exceeded."

Work at the mine was stopped shortly after Mr. Scrivenor's visit.

PASOH.—The flat ground in the jungle, between the railway and this mine, is pitted with numerous gold-workings. At the mine itself little can now be seen; the unerected machinery still remains, and occasional large boulders of granite with porphyritic felspars are lying about on the hill-side. The following account is extracted from Mr. Scrivenor's report :—

"The mine at Pasoh is situated on the side of a steep hill close to the Pahang border. Preparations for serious work were made, as can be seen by the amount of machinery stored on the mine, but unerected."

"The geology of Pasoh is very interesting in connection with gold mining. In the first place, the lode behind the shaft, giving prospects of 5-6 dwt., is an igneous rock, a granophyre with no trace of a ferro-magnesian mineral. The other rocks composing this part of the hill are—granite with large porphyritic crystals of felspar; gneiss with tourmaline that has been affected by the shearing; and hornblende schist that is probably drived from a diabase. The granophyre is for the most part intensely sheared—in fact, were it not for small eyes that have escaped it would be impossible to determine its nature.† At one of the shafts near the battery site more hornblende schist and gneiss occur. When exposed *in situ* the trend of the shear planes in these rocks is northerly; and at least two lines of weakness, analogous to that at Raub, are represented."

"It would appear from the relations of the granite, gneiss, and hornblende schist in the field and the examination of slides that the hornblende schist has been derived from a basic intrusive rock cutting, and therefore of later date than, the granite. That this is not impossible is borne out by a very clear exposure in the headland at Kuantan, Pahang, where four small dykes of diabase are seen traversing granite. Since then, in Pahang, "a greenstone" has been found to be altered by the granite owing to contact metamorphism, there must either be two distinct ages of granite or two distinct sets of "greenstones;" and that the latter is the correct interpretation is, I think, shown by the fact that the Kuantan headland granite, although situated in a district where shale and sandstone have been enormously disturbed, is itself in no way affected."

*The rocks, their relations to one another, and to similar rocks in other parts of the world, formed the subject of a paper in the *Geological Magazine*, pp. 44-6, October, 1916.

† "Divisional places in this granaphyre show beautiful dendritic crystals of manganese dioxide, which have given rise to the statement that 'fossil ferns' occur at Pasoh."